DOE–EM/GJ1475–2007

*Office of Environmental Management – Grand Junction*

MOAB UTAH

UMTRA Project

# Moab UMTRA Project Site Storm Water Pollution Prevention Plan

May 2007

U.S. Department of Energy

Office of Environmental Management

*Work Performed Under DOE Contract No. DE–AC01–02GJ79491*
*for the U.S. Department of Energy Office of Environmental Management.*

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**Moab UMTRA Project**

# Moab UMTRA Project Site
# Storm Water Pollution Prevention Plan

**May 2007**

Work Performed by S.M. Stoller Corporation under DOE Contract No. DE–AC01–02GJ79491 for the U.S. Department of Energy Office of Environmental Management, Grand Junction, Colorado

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# Revision Schedule

This storm water pollution prevention plan (SWP3) will be revised and updated to address changes in scope, site conditions, new or revised governmental regulations, and additional on-site storm water pollution controls. Revisions or modifications to the plan must be incorporated within 7 days following the inspection.

All revisions to the SWP3 must be documented on the following Revision Documentation Form, below. The signature of the manager attests that the SWP3 revision information is true and accurate. Previous authors and facility representatives are not responsible for the revisions.

**SWP3 Revision Documentation Form**

| Revision Number | Date | Author | Manager Signature |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
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| 10 | | | |

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# 1.0 Introduction

## 1.1 General

The Moab Uranium Mill Tailings Remedial Action (UMTRA) Project Site (Moab Site) formerly contained a privately operated uranium ore processing facility that ceased operations in 1984. Radioactive materials, including a large tailings embankment are remainders from the ore processing operation. The site is located approximately 3 miles northwest of the City of Moab in Grand County, Utah (Figure 1).

The radioactive contaminants (i.e., uranium mill tailings) at the Moab Site are best described as a fine-grained, sand-like material that is highly susceptible to wind and water erosion. Consequently, one of DOE's major objectives at the Moab Site is to control erosion and contain off-site transportation of these contaminants resulting from the erosive forces of wind and storm water. This Storm Water Pollution Prevention Plan (SWP3) outlines DOE's strategy for controlling the off-site transportation of sediment and identifies strategies to protect public waterways from contamination resulting from storm water runoff at the Moab Site. It also describes current site conditions, issues of potential concern as they could affect control of discharge of sediment from disturbed areas, typical maintenance activities, and identifies Best Management Practices (BMPs), which, when properly implemented, will assist in erosion control.

## 1.2 Purpose

The purpose of this SWP3 is to meet State of Utah storm water requirements (described in Section 1.3), and to provide BMPs and guidance related to erosion and storm water control that can be used as needed for future maintenance projects. In addition, this plan provides general guidance for managing situations that may develop related to weather or other natural situations (e.g., high winds, extreme runoff, unanticipated loss of surface cover) and that may require soil stabilization. Exposed soil may potentially result in erosion and thereby compromise the existing ground surface, including exposure of contaminated materials. BMPs are identified for the control of sediment during storm events and to prevent the off-site releases of all sediments. This document proposes guidelines and suggests BMPs that could be applied to future activities.

BMPs are those practices that are accepted by industry and the state and federal oversight authorities as effective for controlling sediment transport and thereby managing potential erosion. These may include restrictions related to weather conditions or, physical materials that, once in place, will mechanically control movement of soil particles.

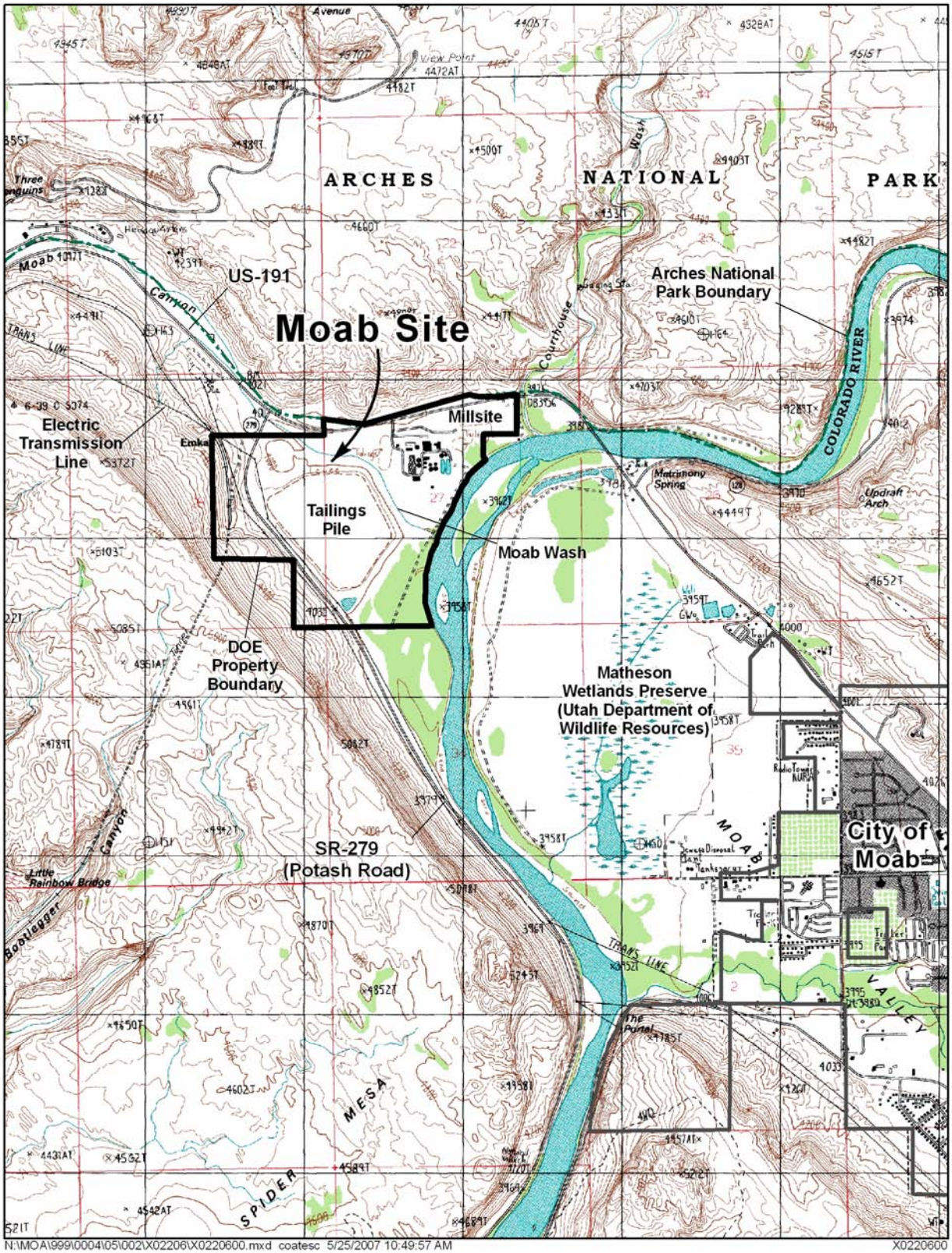



*Figure 1. Location of the Moab Site in Relation to the City of Moab*

## 1.3 Applicability of Utah General Construction Permit

This SWP3 is prepared in accordance with the requirements of the *Utah Pollutant Discharge Elimination System (UPDES), Storm Water General Permit for Construction Activities*. State of Utah regulations require a UPDES storm water discharge permit for "… construction activities including clearing, grading, and excavating…" that result in a land disturbance of one or more acres (U.A.C. R317-8-3.9 (6)(d)(10)). The intent of these regulations is to prevent erosion and to prevent or control sediment transport from disturbed areas.

The UPDES *Storm Water General Permit for Construction Activities* prescribes the content and information to be reported in a site-specific SWP3. In accordance with the terms and conditions of the UPDES *Storm Water General Permit for Construction Activities*, this SWP3 will be kept on-site, and will be made available to the *Executive Secretary* (or authorized representative) of the Utah Water Quality Board; interested members of the public; and local government officials. There is no requirement to submit this plan to the State for approval.

In addition to being regulated as a "construction site," the Moab Site also meets the regulatory definition of a facility that was previously engaged in the mineral industry as described in the Standard Industrial Classification (SIC) codes 10 through 14 (Metal Mining). This grouping of industries includes both mining and milling facilities. The SIC code 10.94 specifically identifies facilities which mined, milled, or otherwise processed uranium, radium, or vanadium ores. These facilities are specifically regulated at Section R317-8-3.9 (6)(d)(3) (U.A.C., September 2001). These regulations stipulate that a storm water discharge permit is required for facilities where storm water may "… come into contact with any overburden, raw materials, intermediate products, finished products, byproducts or waste products located on the site of such operations".

This SWP3 addresses activities and operations currently conducted or planned for the future by the DOE at the Moab Site. The plan conforms to current State of Utah rules and requirements for controlling erosion and storm water discharges associated with construction activity (i.e., construction sites) as described above.

A site construction map with locations of specific BMPs is included in this plan and will be maintained on-site. The information provided in this SWP3 complies with the format and outline required by the UPDES *Storm Water General Permit for Construction Activities.*

As revisions to this plan become necessary, they will be added to the text and documented on the Revision Schedule (Page v). Revisions or modifications to the plan must be incorporated within 7 days following an inspection.

Appendix A contains a copy of the State of Utah Notice of Intent to file for a Storm Water Permit and state acceptance.

# 2.0 Site Description

## 2.1 Site Ownership and Physical Location

As required by the Utah Division of Water Quality, the following site ownership information is provided:

1) **Name of Operation:** Moab UMTRA Project Site, formerly known as the Atlas Uranium Mill.

2) **Owner/Operator Information:** U.S. Department of Energy, Grand Junction Office. 2597 B3/4 Road, Grand Junction, Colorado 81503. DOE Contact: Donald R. Metzler (970) 248-7612. On-Site Contact: Irwin Stewart (435) 259-5131.

3) **Physical Address of Operations:** 2021 North US-191, Moab, Utah 84532.

4) **Longitude/Latitude of Operation (at Main Office):**

   **Latitude:** 38 degrees, 36 minutes, 17.53329 seconds - North
   **Longitude:** 109 degrees, 35 minutes, 23.47893 seconds - West
   **Elevation:** 3977.6 US feet above MSL

## 2.2 History

The Moab Site consists of a former uranium ore processing facility that was originally owned and operated by the Uranium Reduction Company and subsequently by the Atlas Minerals Corporation. The mill ceased operations in 1984 and was subsequently dismantled with the exception of one building that DOE currently uses for maintenance. Although the former mill is no longer active, a total of approximately 12 million cubic yards of uranium mill tailings and surface contaminated soils remain at the Moab Site. The majority of the mill tailings are contained within an on-site tailings embankment, the footprint of which covers approximately 130 acres; the top of the embankment averages 94 feet (ft) above the Colorado River. Although the milling process recovered about 95 percent of the uranium, the residues, or tailings, contain several naturally occurring radioactive elements. Decommissioning of the mill began in 1988, and an interim cover was placed on the tailings pile between 1989 and 1995.

To minimize potential adverse effects to human health and the environment in the short term, DOE instituted environmental controls and began various interim measures in 2002. Controls have included storm water management, dust suppression, pile dewatering actions, and placement of an interim cover on the tailings to prevent movement of contaminated windblown materials from the pile. In 2005, An Environmental Impact Statement was completed and approved that describes proposed actions related to moving the contaminated materials from the existing processing site to a selected disposal site, located approximately 30 miles north on US-191, and called the Crescent Junction Disposal Site (DOE 2005).

## 2.3 Description

The Moab Site is generally irregularly shaped and is situated between the Colorado River and U.S. Highway 191 (US-191). The entire property consists of 439 acres, with the disturbed portion of the site covering an estimated 350 acres; the remaining approximately 90 acres is predominately located on the hillside west and above State Route 279 (SR-279). The uranium mill tailings embankment covers 130 acres and is located west of Moab Wash.

The Moab Site is bordered on the north and southwest by steep sandstone cliffs. The Colorado River forms the southeastern boundary of the site. US-191 parallels the northern site boundary, and SR-279 parallels the southwestern boundary. Arches National Park is located adjacent to the northern site boundary, and Canyonlands National Park is located approximately 12 miles to the southwest. The Cane Creek Branch of the Union Pacific Railroad traverses a small section of the site just west of SR-279. Figure 1 provides general locational information.

The majority of the eastern portion of the Moab Site has been remediated and there are ongoing efforts to establish native vegetation in order to maintain a stable soil surface and reduce fugitive dust and erosion. A new construction water/irrigation pond was created in this area in 2006 and the former pond was removed.

Buildings on site include various components of the project, such as offices, restrooms, laundry facilities, a decontamination area, etc. Surrounding the buildings is a basically flat remediated area that is being stabilized with vegetation. A pump inlet structure is situated along the Colorado River approximately 1,200 feet northeast of Moab Wash. The construction water/irrigation pond, which occupies approximately 2.0 acres, is south of the central building area. The majority of the area east of Moab Wash is flat.

Moab Wash is a major, however ephemeral, surface water feature that runs in a southeasterly direction through the center of the site and empties into the Colorado River. The wash flows only during and after precipitation events. During periods of high water, Moab Wash and the area south of Moab Wash may be used as preferred habitat by two endangered fish, the Colorado pikeminnow (*Ptychocheilus lucius)* and Razorback sucker (*Xyrauchen texanus*). A backwater area parallel to the river as well as the mouth of Moab Wash inundates during high river flow. A berm isolates all runoff from the tailings embankment into a sediment basin to avoid river and backwater area contamination.

Jurisdictional wetlands, regulated by the Army Corps of Engineers, occur along the southeast Moab Site boundary adjacent to the Colorado River. They are protected from possible contaminated site runoff by existing berms that parallel the river.

The Colorado River 100-year floodplain can potentially flood large areas of the southeastern portion of the site. The extent of the 100-year floodplain and the location of wetlands are shown on Figure 2.

The Moab Site has been divided into four drainage basins based on the 25- and 100-year storm events. These drainage basins are shown on Figure 3 with the calculated storm water event water volumes and elevations.

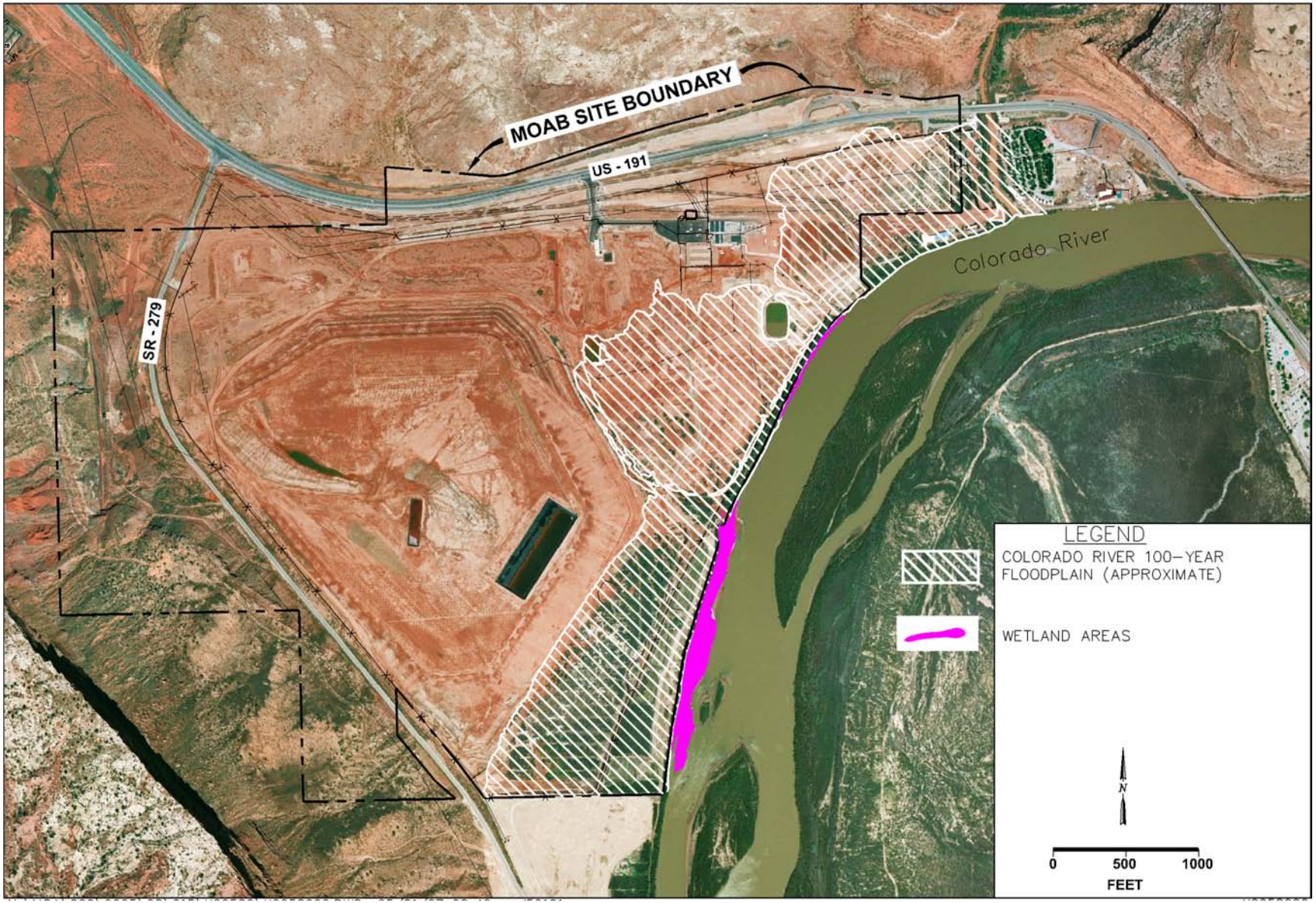
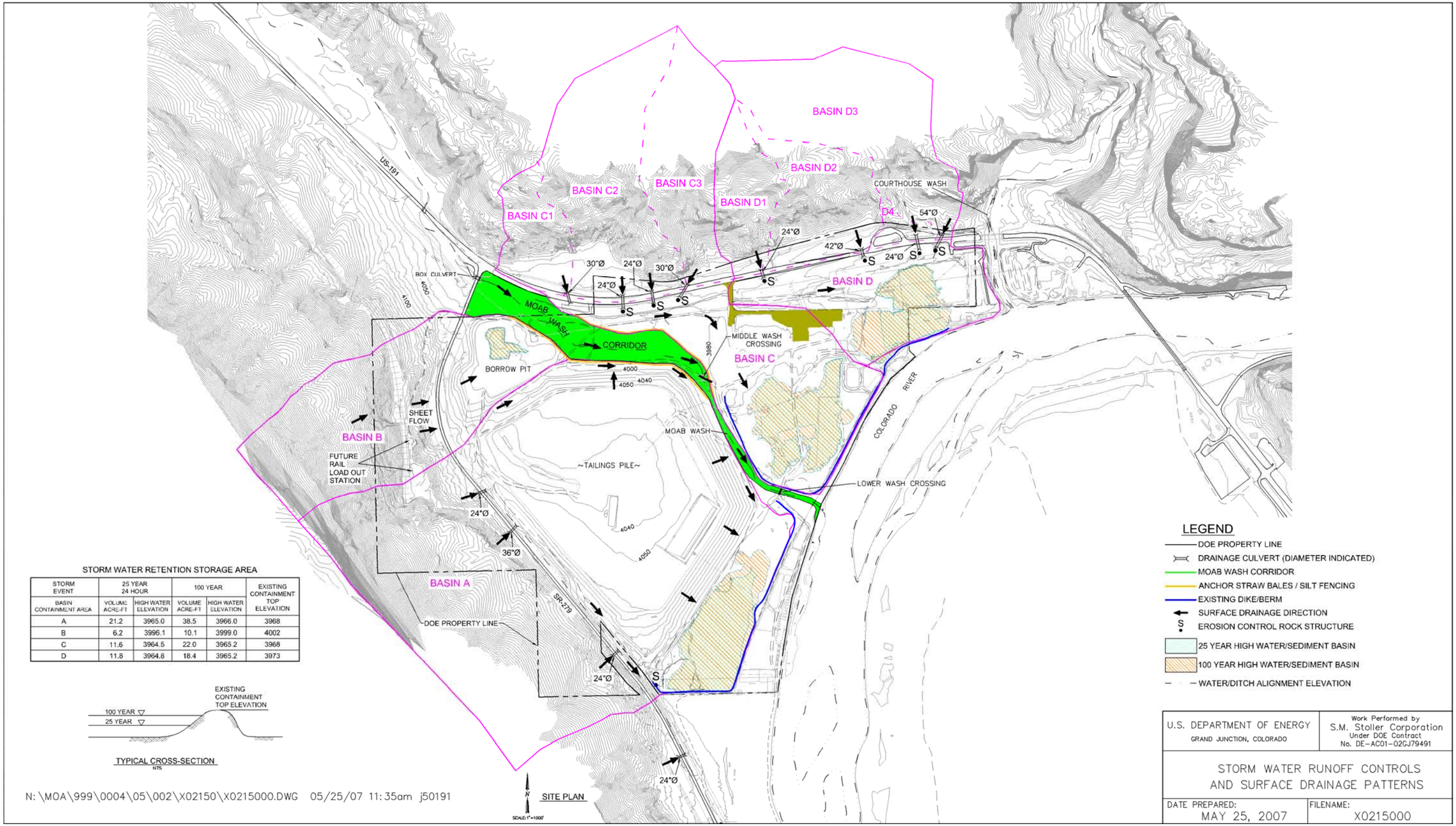



*Figure 2. Location of the 100-Year Floodplain of the Colorado River and Location of Wetlands at the Moab Site*




STORM WATER RETENTION STORAGE AREA

| STORM EVENT | 25 YEAR 24 HOUR | | 100 YEAR | | EXISTING CONTAINMENT TOP ELEVATION |
|---|---|---|---|---|---|
| BASIN CONTAINMENT AREA | VOLUME ACRE-FT | HIGH WATER ELEVATION | VOLUME ACRE-FT | HIGH WATER ELEVATION | |
| A | 21.2 | 3965.0 | 38.5 | 3966.0 | 3968 |
| B | 6.2 | 3996.1 | 10.1 | 3999.0 | 4002 |
| C | 11.6 | 3964.5 | 22.0 | 3965.2 | 3968 |
| D | 11.8 | 3964.8 | 18.4 | 3965.2 | 3973 |




TYPICAL CROSS-SECTION
NTS

N:\MOA\999\0004\05\002\X02150\X0215000.DWG 05/25/07 11:35am j50191

SITE PLAN
SCALE: 1"=1000'

LEGEND

- DOE PROPERTY LINE
- DRAINAGE CULVERT (DIAMETER INDICATED)
- MOAB WASH CORRIDOR
- ANCHOR STRAW BALES / SILT FENCING
- EXISTING DIKE/BERM
- SURFACE DRAINAGE DIRECTION
- S EROSION CONTROL ROCK STRUCTURE
- 25 YEAR HIGH WATER/SEDIMENT BASIN
- 100 YEAR HIGH WATER/SEDIMENT BASIN
- WATER/DITCH ALIGNMENT ELEVATION

| U.S. DEPARTMENT OF ENERGY GRAND JUNCTION, COLORADO | Work Performed by S.M. Stoller Corporation Under DOE Contract No. DE-AC01-02GJ79491 |
|---|---|
| STORM WATER RUNOFF CONTROLS AND SURFACE DRAINAGE PATTERNS | |
| DATE PREPARED: MAY 25, 2007 | FILENAME: X0215000 |

*Figure 3. Storm Water Runoff Controls and Surface Drainage Patterns at the Moab Site*

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## 2.4 Climate, Soils, and Vegetation

The climate of the Moab region is semiarid. The average annual temperature is approximately 56 degrees Fahrenheit (ºF). January is the coldest month, averaging 30ºF, and July is the warmest month, averaging 82ºF. Extreme temperatures have ranged from -18ºF in January 1963 to 111ºF, which has occurred more than once (in July 1953 and on earlier occasions). Temperatures of 90ºF or higher occur about 100 days per year, with about 80 percent of those occurring during June, July, and August. Temperatures below freezing (32ºF) occur on the average of 123 days of the year with about 80 percent of those occurring during November through February.

Average annual precipitation at Moab is 9 inches, distributed approximately equally among the seasons with slight peaks during the spring and fall. The driest months are February and June, which have precipitation slightly less than 0.5 inch. The wettest months are October and April, which have average precipitation of about 1.15 inch and 1.0 inch, respectively. Annual precipitation is greatly exceeded by potential evapotranspiration (about 50 inches per year annually), potential or pan evaporation (about 60 inches annually), and lake evaporation (about 38 inches annually).

Thunderstorms occur about 40 days per year. Hail occurs approximately 3 days per year.

Prevailing winds in the Moab region are from the southwest and southeast. Wind speeds are less than 1 mile per hour (mph) 75 percent of the time; wind speeds are 1 to 7 mph 95 percent of the time. The highest wind speed recorded at Moab was 80 mph. Cold air drainage at the Moab Site could occur from the northwest under very stable conditions.

Surface soils in disturbed areas of the sites are predominantly sands mixed with clays, silts, and gravels and are saturated within 16 feet of the surface most of the year. Remaining native soils surrounding the site are predominantly sands mixed with clays, silts, and gravels and are classified as Nakai fine sandy loams. Soils include sandy loams to loamy fine sands. Soils are generally deep (depths greater than 36 inches), are well drained, and have a minimal water-erosion potential, a moderate hazard of blowing potential, and an estimated erosion rate of 3 tons per acre per year (DOE 2005).

The runoff coefficient, *C,* for unimproved, vacant lands for the given soil type is 0.05 (DRCG 1978). The anticipated runoff coefficient after completion of these construction activities will remain essentially the same.

The majority of the Moab Site is in a disturbed state. Vacant areas that were contaminated have been remediated and reclaimed by seeding and plantings with native species. There is no vegetation growing on the tailings embankment or on the majority of the site. Areas along the Colorado River are dominated by riparian and wetland species such as tamarisk and willows. Scattered desert plant communities dominate steep areas west of SR-279 or north of US-191. The riparian areas as well as the steep surrounding slopes will not be disturbed.

## 2.5 Description of Site Drainage

The Moab Site has been divided into four drainage basins that are designed to control drainage across the site and into sediment basins for evaporation. These basins are shown on Figure 3 and discussed below. The physical extent of the drainage basins is based on computer modeling of upslope and off-site topography and expected surface runoff. Storage volume per 25- and 100-year storms is provided on Figure 3.

Moab Wash bisects the site from a northwesterly to southeasterly direction and is a common boundary for three of the drainage basins. Because it connects to the Colorado River, it is physically segregated from interconnection with any of the drainage basins.

### 2.5.1 Moab Wash

Moab Wash forms one boundary for Drainage Basins A, B, and C. Surface runoff will be prevented from entering Moab Wash through use of anchored straw bales and/or silt fencing along perimeter areas of the wash. Moab Wash is the major drainage feature for on-site surface runoff, but it also transports and discharges runoff with sediment collected from a large off-site area.

Moab Wash contains an ephemeral stream that flows only during or after major storm events. It is DOE's goal to control and prevent surface and storm water runoff and/or sediment originating on the Moab Site property from entering Moab Wash. As a result, the only sediment that will be discharged to the Colorado River through Moab Wash, will be sediment and runoff collected from the watershed areas upstream from the Moab Site.

DOE has obtained a permit to re-align the channel and intends to reinforce two crossings with rock surfaces and large drainage culverts.

### 2.5.2 Drainage Basin A

Drainage Basin A contains the tailings embankment and areas to the west and across SR-279. These areas are variably sloped and surface runoff will drain through culverts between 24 and 36 inches in diameter, which are shown on Figure 3. The surface runoff is channeled southeasterly to a sediment basin that is bermed to isolate collected water from reaching the Colorado River. Between the river and the berms are jurisdictional wetlands and the backwater areas previously described that are potentially important nursery areas for endangered Colorado River fish.

The majority of Drainage Basin A is characterized by loose, poorly consolidated sediments. There is poor vegetative cover in some areas and no vegetation on the tailings embankment itself. The areas across SR-279 are often steep with some rock outcrops. The tailings embankment area is the location where most of the future anticipated activity or disturbance on-site will occur. Because both the native soils and uranium mill tailings possess a sand-like texture, these materials are easily eroded. Water is used to control fugitive dust on the pile.

### 2.5.3 Drainage Basin B

Drainage Basin B includes the area to the northwest of the tailings pile and an area west of SR-279. A former borrow pit will be used as part of the sediment basin for this area. Much of the terrain west of the highway could be characterized as steep with rocky outcrops.

### 2.5.4 Drainage Basin C

This drainage area is divided into three smaller basins, all of which originate north of US-191 and on land within Arches National Park. Four, 24- to 30-inch-diameter culverts will channel surface runoff under the highway and toward sediment basin C on the Moab Site. At the down slope edge of the culverts, rock will be placed to prevent undercutting of the culvert. Areas to the north of the highway are steep and rocky.

The majority of Drainage Basin C has been remediated and is being stabilized by native vegetation. This area contains the site entrance and the majority of the site facilities. A construction water pond that is also used for irrigation water to maintain site vegetation is in this area.

An existing berm segregates surface runoff from reaching the Colorado River. As shown on Figure 2, there are jurisdictional wetlands between the river and the berm

### 2.5.5 Drainage Basin D

Drainage Basin D is also comprised of several smaller basins, which are shown on Figure 3. This basin includes a large off site area that is part of Arches National Park and is basically bounded by Courthouse Wash on the east side. Four culverts drain surface runoff below US-191. The culvert outlets will be protected from undercutting with rock riprap. The areas north of the highway are generally steep and rocky while south of the highway the majority of the site is basically flat and has been vegetated with native perennial species.

# 3.0 Site Project Descriptions

The extent and nature of construction activities planned for the Moab Site will depend on the specific construction activities and sequencing developed by the as yet identified remedial action contractor. However, it is anticipated that 350 acres will be disturbed as a result of various construction and remedial activities. Typical current and anticipated activities and disturbed areas are described below and also summarized on Table 1.

## 3.1 Description of Ongoing Processes and Site Activities

Currently, DOE continues to ensure erosion controls are in place and working as intended at the Moab Site. As the project progresses, various new erosion and sediment control devices will be implemented as necessary. Ongoing site activities and their potential to contribute to storm water discharges are discussed below.

### 3.1.1 Examples of Site Characterization and Maintenance Activities

DOE continues to conduct radiological characterization, surface and ground water monitoring, radon and direct gamma radiation monitoring, environmental air/particulate monitoring, meteorological monitoring, and various engineering studies and surveys. Most of these types of activities are ongoing and non-intrusive and result in little to no new land disturbance.

In addition, native vegetation plantings require irrigation watering and monitoring for noxious weed infestations. Occasionally, new areas are planted or replanted as needed to stabilize exposed soil areas. Other maintenance activities may include fence or sign maintenance.

### 3.1.2 Continued Maintenance of Fugitive Dust and Storm Water Runoff Controls

DOE recognizes that mill tailings and residual radioactive contaminated soils are especially vulnerable to wind and storm runoff. In an effort to contain these contaminants and prevent their migration off-site, maintaining fugitive dust and storm water runoff controls is a priority for DOE. Maintenance of these controls and the addition of new controls may necessitate the use of heavy equipment. New land disturbances associated with these activities are expected to be minimal.

## 3.2 Anticipated Future Activities at the Moab Site

At the time of this writing, the following activities are proposed for the Moab Site. DOE will continue with various site preparation activities that will likely result in small area disturbances.

### 3.2.1 Moab Wash Crossings

Stabilizing and creating safe crossings of Moab Wash is projected to occur during the 2007-2008 time frame. This will entail installing up to five, 48-inch culverts at the proposed middle crossing and an open rock-lined crossing at the lower crossing. The top of the middle crossing will be weir-shaped to handle large discharges and will be stabilized with grouted rock for safe vehicle travel.

### 3.2.2 Stabilize Berms

Another proposed work activity is ensuring that all berms are stable and able to contain the 25- and 100-year storm events. The berms also act as sediment basins for each of the four drainage basins. Heavy equipment will be required to reconfigure various areas on the berms, including the berm in the southeast corner of the site. Any disturbance would cover a small area and appropriate controls, as necessary to contain sediment or prevent erosion, would be employed. These small areas would cover slightly more than one acre in various areas.

### 3.2.3 Drainage Controls at Rail Load Out Area

DOE will install drainage controls at the proposed rail load out area, which is located west of SR-279 and in the location of an existing disturbed area. These will consist of drainage ditches and water bars to dissipate and direct flows to culverts and sediment basins.

### 3.2.4 Remediation of Land East of Moab Wash

DOE will continue to remediate contaminated soil. It is likely that the next area to be remediated will be land east of Moab Wash and west of the support facilities and the construction water pond. Contaminated soils will be removed and areas will be revegetated with native species. Storm water drainage and controls will be re-established following remediation.

### 3.2.5 Realignment of Moab Wash

To reduce the potential for contaminated soil and tailings to move off-site into the Colorado River, DOE intends to realign Moab Wash under a Corps of Engineers 404 Permit. As a result of the realignment activities, the channel flow capacity will be increased (for the 100-year storm event) and the banks will be stabilized with vegetation, erosion matting, and rock armoring, thus reducing erosion potential. In general, grading and ditching will be used to minimize sheet flow into Moab Wash to minimize contamination into Moab Wash.

*Table 1. Sequence of Proposed Construction Activities and Estimated Areas of Disturbance*

| Construction Activity And Sequence | Estimated Duration of Task | Total Area of Disturbance Requiring Storm Water Controls | Post-Construction Run-off Coefficient[1] |
|---|---|---|---|
| 1. Place Straw Bales Along Perimeter of Moab Wash | 1 week | 5 acres | 0.05 |
| 2. Construct Lower Moab Wash Crossing | 4 weeks | 0.5 acre | 0.05 |
| 3. Construct Middle Moab Wash Crossing | 10 weeks | 1 acre | 0.05 |
| 4. Stabilize Berms | 4 weeks | 2 acres | 0.05 |
| 5. Construct Drainage Controls at Rail Load Out | 4 weeks | 0.5 acre | 0.05 |
| 6. Remediate Area East of Moab Wash | 12 weeks | 30 acres | 0.05 |
| 7. Realign Moab Wash | 16 weeks | 25 acres | 0.05 |
| 8. Fugitive Dust Control | Ongoing | Entire site | 0.05 |
| 9. Vegetation Monitoring | Ongoing | Entire site | 0.05 |

[1] DRCG 1978

## 3.3 Post Remediation Site Conditions

It is anticipated that completion of remediation will take 20 years or more. However, after all areas have been stabilized, surface conditions shall be returned to the pre-development conditions of relatively flat topography. The anticipated future use of the Moab Site is a park-like setting that would contain riparian and desert vegetation communities dominated by saltbrush and Indian ricegrass communities.

# 4.0 Description of Storm Water Controls

Because the Moab Site contains significant quantities of contaminated materials (i.e., uranium mill tailings), and because a large percentage of the site has been previously disturbed and is susceptible to severe erosion, DOE's primary objective is to contain all on-site runoff, to the greatest extent practicable. Figure 3 illustrates the surface drainage patterns and the storm water and erosion controls that will be used at the Moab Site. Storm water and erosion controls to be implemented at the Moab Site are summarized below and details for each practice are provided in Appendix B.

## 4.1 Erosion and Sediment Controls

**Tailings Embankment Temporary Cover:** The temporary cover installed on the tailings embankment reduces erosion and subsequent off-site transportation of the mill tailings. The cover is generally between 6 and 12 inches thick, and consists mostly of low-level contaminated sandy soils excavated from on-site borrow sources. The cover itself is susceptible to erosion because no vegetation has been established on the tailings pile. It is anticipated that periodic maintenance will be required to prevent cover materials from eroding (primarily from the side slopes). Clean soils will be used to "patch" areas on the side slopes if storm water erodes through the cover material and exposes the underlying mill tailings.

**On-Site Berms:** Four berms have been constructed on the Moab Site in critical locations to intercept sheet flow and contain storm water runoff. The berms are sized to prevent storm water runoff from reaching the adjacent Colorado River. Figure 3 provides the locations of the berms.

**Anchored Straw Bales:** As shown in Figure 3, certified weed-free straw bales will be anchored to form a linear sediment barrier along portions of the perimeter of Moab Wash. As with all sediment and storm water controls, the straw bales will be inspected at regular intervals and replaced as necessary.

**Rock Armoring:** Use of rock materials for armoring slopes, bank stabilization, culverts, check dams, etc., will be used as appropriate. Surfactants (e.g., magnesium chloride or calcium chloride) will be used on designated roads to maintain them in good usable condition and to prevent rutting and tracking of sediment.

**Silt Fencing:** A synthetic silt fence fabric will be used whenever additional sediment/erosion controls are needed to augment existing controls, or, where the above controls cannot be feasibly implemented.

## 4.2 Stabilization Practices

**Vegetative Buffer Strip:** The UPDES *Storm Water General Permit for Construction Activities* specifically identifies the preservation of existing areas of vegetation as valuable storm water buffer and sediment stabilization controls. Almost the entire length of the eastern Moab Site boundary is bordered by the Colorado River. This border contains a dense growth of tamarisk, willows, and other wetland and riparian vegetation. This strip of vegetation serves as an efficient filter of storm water and sediment and is an effective, natural barrier between the disturbed portions of the Moab Site and the nearby Colorado River. DOE will make every attempt to preserve and protect the native vegetation along the Colorado River to ensure that site sediments, contaminants, and runoff remain on site.

**Vegetation:** As various areas on site are remediated, native vegetation will continue to be planted to stabilize and protect bare soil areas. Ongoing maintenance and noxious weed control will continue.

**Soil Stabilizers:** Various soil stabilizing agents may be approved for use in areas where sediments are particularly vulnerable to erosion such as the tailings pile cover, side slopes, soil borrow areas, and in areas where significant activity is expected (e.g., site roads). Soil stabilizers/conditioners may include various chemical-based agents and surfactants e.g., polymers, calcium/magnesium chloride, lignum sulfate, and tackifiers.

Non-chemical based soil stabilizing controls that may also be used include fiber mats and mulches to establish temporary plant covers in critical locations.

## 4.3 Structural Controls

**Storm Water and Sediment Retention Ponds:** As shown on Figure 3, four storm water and sediment retention basins are in place at the Moab Site that are designed to capture and contain on-site storm water runoff and sediment: (1) The former northwest soil borrow area in Drainage Basin B captures runoff from the northwest corner of the site property; (2) The top of the tailings embankment itself is inverted and captures runoff that falls directly on top; and (3) the bermed area immediately south of the tailings embankment will capture runoff from the western site boundary and from the side slopes of the embankment; it is also parallel to the Colorado River and acts as a containment structure to isolate runoff and sediment from the river. Other berms are located parallel to the Colorado River and also are perimeter controls for Drainage Basins C and D.

**Site Drainage and Grading:** All drainage features at the Moab Site will be routinely evaluated to identify whether site drainage controls require adjustments, improvements and/or repairs. As part of the storm water inspection process, it may be determined that certain areas are in need of ongoing maintenance to ensure that site drainage does not discharge to Moab Wash or to the Colorado River. These maintenance actions may entail grade adjustments, culvert installations and repair, installation and repair of berms and dikes, installation of runoff interception ditches, etc.

Table 2 provides a summary of storm water and erosion controls for the Moab site.

*Table 2. Summary of Storm Water and Erosion Controls for the Moab Site*

| Sediment Source | | Storm Water Controls | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Earthen Berms | Storage and Containment | Vegetative Cover | Chemical -based Soil Stabilizers | Anchored Straw Bales, Silt Fencing | Rock Armor (Riprap, Gravel, etc.) | Other (Fiber Mat, Tackifier, Rock Check Dam, etc.) | Drainage Improvements (Grading, Ditches Culverts, etc) | No Controls |
| **High Potential Areas** | Tailings Pile (Top) | | X | | X | | | | | |
| | Tailings Pile (Side Slopes) | X | | | X | | | X | | |
| | Tailings Pile (Base) | X | X | | | | | | X | |
| | Moab Wash Corridor | X | | X | | X | X | X | X | |
| **Moderate Potential Areas** | North and East Portions of Moab Site | X | | X | X | X | | | X | |
| | Site Roads | | | | X | | X | | X | |
| **Low Potential Areas** | US-191 and SR-279 Corridors (east and north) | X | | X | | | | | X | |
| | River Bottom/ Wetland Areas (South/East) | | | | | | | | | X |
| | Sandstone Slopes/Cliffs (East/South) | | | | | | | | | X |

## 4.4 Best Management Practices

BMPs will be followed at the Moab Site to help minimize on-site erosion and the off-site discharge of sediment. Table B−1 describes inspection and maintenance requirements of various BMPs that may be used at the Moab Site. Selected BMPs are described below.

**Roads:** All on-site traffic will be restricted to specific designated roads, which are shown on Figure 3. Off-road travel will only be authorized on a case-by-case basis (e.g., access to a remote monitoring wells, conduct radiological assessments, etc.). Traffic speed will also be restricted to an appropriate level on all designated roads.

**Evaluation of Chemical-Based Soil Stabilizer Use:** Use of various chemical soil stabilizers/dust suppressants (e.g., surfactants, salt-based soil conditioners, etc.) shall be done in accordance with the recommended end uses for those products. Site personnel shall not exceed

the manufacturer recommended application rates. Material Safety Data Sheets for all such materials used at the Moab Site shall be reviewed and approved by the Environmental Services organization. Prior to application, site personnel shall determine and evaluate if the use of the soil conditioner could interfere with other site monitoring activities or cause other harm to the environment (e.g., runoff into critical habitat for threatened or endangered fish).

**Decontamination**: Prior to leaving the Moab Site, all heavy equipment and vehicles will be washed and decontaminated at a decontamination pad. This practice will minimize the potential for any off-site tracking of sediment or contaminants.

**Covered Loads:** Any trucks hauling materials off site shall be tarped and covered to minimize fugitive dust and the loss of materials in transit or off site. All loads shall be inspected to ensure that they are properly covered prior to departure.

**Spill Response:** In the event of a spill or release of contaminated materials off site, the spilled materials will be immediately contained and cleaned up. Emergency spill response actions are outlined in Section 13.0 of the *Moab Project Health and Safety Plan* (DOE 2007).

**Best Management Practice Areas (BMPAs):** BMPAs will be established at the Moab Site for the purposes of consolidating various types of waste materials requiring segregation (e.g., petroleum contaminated soils, asbestos wastes, etc.). Isolating and consolidating such wastes into designated material storage areas minimizes the potential that contaminants exposed to storm water runoff will be further dispersed into the environment.

# 5.0 Maintenance, Inspections, and Notifications

## 5.1 Maintenance

Recommended maintenance activities per type of erosion or sediment control are provided on Table B−1, General Maintenance and Inspection Requirements. This table provides general specifications and requirements. In addition, examples of BMPs with appropriate installation methods and applicability are provided in Appendix C, Examples of Best Management Practices.

## 5.2 Inspections and Notifications

Site personnel will inspect all storm water controls for evidence of damage (e.g., replacement of straw bales, additional silt fencing needed, repair of berms, cleaning plugged culverts, etc.). Using the *Moab Site Storm Water and Erosion Control Checklists* (Appendix B), site personnel will document the condition of the storm water controls and any maintenance actions that may be necessary after each inspection. Any required maintenance actions must be reported to the on-site manager within 24 hours of the inspection. The on-site manager will ensure that the appropriate repairs or maintenance actions are performed in a timely manner. Inspections of disturbed areas may be done at any time; however, the UPDES defines mandatory inspections as follows.

In the event that a major release of contaminated material were to occur (e.g., breach of a storm water retention basin containing contaminated runoff water, etc.), the inspector(s) will immediately notify the on-site manager and follow the emergency reporting and notification procedures as outlined in Sections 11.0 and 13.0 of the *Moab Project Health and Safety Plan* (DOE, 2007).

### 5.2.1 Routine Inspections

As required by the UPDES *Storm Water General Permit for Construction Activities*, site personnel shall inspect disturbed areas of the construction site that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, structural control measures, and locations where vehicles enter or exit the site at least once every 14 calendar days (bi-monthly) or before anticipated storm events. However, for areas temporarily stabilized, runoff is unlikely due to winter conditions, or during seasonal arid conditions, inspections can be conducted at least once a month.

The results of routine inspections are recorded on Table B−2, Routine Erosion and Sediment Control Inspection Form. If the site is found to be in compliance with this SWP3, then the inspector shall sign the inspection form, certifying compliance.

Areas that have been seeded shall be inspected once a month to ensure that measures related to vegetation success are in place and that seeding efforts have not been compromised by weeds or other factors. Table B−3, Moab Site Environmental Erosion Control and Revegetation Inspection Form provides inspection requirements.

### 5.2.2 Post Storm Inspections

Within 24 hours of the end of a storm that is 0.5 inches or greater, the site erosion and sediment control features shall be inspected and recorded on Table B−4, Post-Storm Erosion and Sediment Control Inspection Form. Precipitation data from an on-site meteorological monitoring station will be used to determine the intensity and duration of storm events and recorded on Table B−3.

## 6.0 Records

Project records generated as a result of this plan will be created and managed in accordance with the Moab working file index and plan and include:

- Storm Water Pollution Prevention Plan for the Moab Project Site (and subsequent revisions);
- The UPDES Storm Water General Permit for Construction Activities;
- Routine or Post-Storm Erosion and Sediment Control inspection checklists;
- General correspondence related to storm water discharges or permitting.

All copies of inspections shall be made and retained as part of this plan for at east three years from the date of final site stabilization. Any incidents of non-compliance must be described and recommendations noted on the forms. If any inspections result in a change to the site description,

modifications to this plan must be made within 7 calendar days, and noted on the Revision Schedule (Page v).

# 7.0 References


Denver Regional Council of Governments (DRCG), 1978. *Urban Storm Drainage Criteria Manual, Volume 1*, Urban Drainage and Flood Control District, September 1978.

Grand Junction Office, 2000. *Moab Site Project Environmental Air Monitoring Sampling and Analysis Plan*, MAC–MOA 1.6-1, Grand Junction, Colorado, February.

———, 2002, *Moab, Utah, UMTRA Project Site, Fugitive Dust Control Plan*, GJO–MOA 1.6-3, Grand Junction, Colorado, February.

———, 2007, *Moab Project Health and Safety Plan*, April 2007, DOE-EM/GJ 1038-2005, Grand Junction, Colorado.

U.S. Department of Energy (DOE), 2005. *Remediation of the Moab Uranium Mill Tailings, Grand and San Juan Counties, Utah, Final Environmental Impact State*, *Volume 1*, July 2005, DOE/EIS-0355.

U.S. Department of Energy (DOE) Order 450.1, *Environmental Protection Program.*

———, DOE Order 231.1, *Environment, Safety, and Health Reporting.*

———, DOE Order 5400.5, R*adiation Protection of the Public and the Environment.*

———, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, DOE/EH–0173T, January 1991.

Utah Administrative Code (U.A.C.), *R317–8-3.9: Utah Pollutant Discharge Elimination System, Storm Water Discharges*, September 2001, Salt Lake City, Utah.

_____, *Utah Pollutant Discharge Elimination System, Storm Water General Permit for Construction Activities*, Permit No. UTR100000, September 2001, Salt Lake City, Utah.

http://www.dot.state.co.is/environmental/envWaterQual/wqms4asp. The Colorado Department of Transportation, Erosion Control and Storm Water Quality Guide.

http://www.cityofreno.com/gov/pub_works/stormwater/pdfs/TruckeeMeadowsBMP_rev01.pdf The *Truckee Meadows Construction Site Best Management Practices Handbook*, by Kennedy/Jenks Consultants, February 2003.

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# Appendix A

# Copy of Storm Water Permit

**STATE OF UTAH, DEPARTMENT OF ENVIRONMENTAL QUALITY, DIVISION OF WATER QUALITY**
288 North 1460 West, P.O. Box 144870, Salt Lake City, Utah 84114-4870 (801)538-6146

# NOI

Notice of Intent (NOI) for Storm Water Discharges Associated with **Construction Activity** Under the UPDES General Permit No. UTR107469

Submission of this Notice of Intent constitutes notice that the party(s) identified in Section I of this form intends to be authorized by UPDES General Permit No. UTR107469 issued for storm water discharges associated with construction activity in the State of Utah. Becoming a permittee obligates such discharger to comply with the terms and conditions of the permit. ALL NECESSARY INFORMATION MUST BE PROVIDED ON THIS FORM.

## I. OPERATOR INFORMATION

Name (Main operator): US Department of Energy Phone: 877 695-5322

Address: 2597 B 3/4 Road Status of Owner/Operator: F - Federal

City: Grand Junction State: UT Zip: 81503

Contact Person: Donald Metzler Phone: 970 248-7612

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Name (1st Co-permittee): Phone:

Address: Status of Owner/Operator:

City: State: Zip:

Contact Person: Phone:

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Name (2nd Co-permittee): Phone:

Address: Status of Owner/Operator:

City: State: Zip:

Contact Person: Phone:

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Name (3rd Co-permittee): Phone:

Address: Status of Owner/Operator:

City: State: Zip:

Contact Person: Phone:

Please copy this form if you have more co-permittees than what is allowed on this form.

## II. FACILITY SITE / LOCATION INFORMATION

Name: Moab UMTRA Project Site

Project No. (if any):

Address: 1871 North Highway 191 County: GRAND

City: MOAB State: UT Zip: 84532

Latitude: Longitude:

Is the facility located on Indian Lands?

(Y or N) N

III. SITE ACTIVITY INFORMATION

Municipal Separate Storm Sewer System (MS4) Operator Name: _____

Receiving Water Body: _____

How far to the nearest water body? _____

List the Number of any other UPDES permits at the site: _____ _____

IV. TYPE OF CONSTRUCTION (Check all that apply)

1. ___ Residential 2. ___ Commercial 3. X Industrial 4. ___ Road 5. ___ Bridge 6. ___ Utility 7. X Contouring, Landscaping

8. X Other (Please list) Environmental Restoration

V. MANAGEMENT PRACTICES

Identify proposed Best Management Practices (BMPs) to reduce pollutants in storm water discharges: (Check all that apply)

1. X Silt Fences 2. X Sediment Pond 3. X Seeding/Preservation of Vegetation 4. X Mulching/Geotextiles 5. X Check Dams 6. X Structural Controls (Berms, Ditches, etc.)

7. ___ Other (Please list) _____

VI. ADDITIONAL INFORMATION REQUIRED

Project Start Date: 05/28/07 Completion Date: 10/01/12 Estimated Area to be Disturbed (in Acres): 350

A storm water pollution prevention plan has been prepared for this site and is to the best of my knowledge in Compliance with State and/or Local Sediment and Erosion Plans and Requirements.

(Y or N) Y (A pollution prevention plan is required to be on hand before submittal of the NOI)

VII. CERTIFICATION: I certify under penalty of law that I have read and understand the *Part I.B.* eligibility requirements for coverage under the general permit for storm water discharges from construction activities.

I further certify that to the best of my knowledge, all discharges and BMPs that have been scheduled and detailed in a pollution prevention plan will satisfy requirements of *Part I.B.* , and *Part III.* of this permit.

I understand that continued coverage under this storm water general permit is contingent upon maintaining eligibility as provided for in *Part I.B.*

I also certify under penalty of law that this document and all attachments were prepared under the direction or supervision of those who have place their signature below, in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: Certification provided online by Ed Baker, Environmental Compliance Lead, Ed.Baker@gjo.doe.gov 05/10/07

Amount of Permit Fee Enclosed: $ 500

# Storm Water Permit Issuance System



## SUCCESS!

Thank you for applying for a Storm Water Permit online! Your notice of intent has been accepted.

**Storm Water Permit Number:** UTR107469

Please print this page as a record of your permit coverage.

**Amount Due: $500.00**

**This permit coverage is not valid until you issue a check for the full amount made payable to the DIVISION OF WATER QUALITY, and send it to:**

**Utah Dept. of Environmental Quality**
**Division of Water Quality**
**P.O. Box 144870**
**Salt Lake City, UT 84114-4870**

### PERMIT INFORMATION

**Permit Registration Date:** 05/10/07
**Permit Expiration Date:** 05/28/12

### PAYMENT INFORMATION

**Payment Method:** CHECK
**Permit Application Fee:** $500.00
**Total Amount Paid:** **UNPAID**

### SITE INFORMATION

**Main Operator:** US Department of Energy
**Contact Person:** Donald Metzler
**Contact Phone Number:** 970 248-7612

**Site Name:** Moab UMTRA Project Site
**Project Number (if any):**
**Street Address:** 1871 North Highway 191
**County:** GRAND
**City, State, Zip:** MOAB, UT 84532
**Latitude:**
**Longitude:**

# Appendix B

# Storm Water, Erosion Control, and BMP Inspection Checklists

*Table B−1. Maintenance and Inspection Requirements*

| BMP Name | Recommended Maintenance /Repair | Inspection Requirements |
|---|---|---|
| **Source Control BMPs:** | | |
| Buffer zones | Inspect areas at limits of construction to ensure flagging is still in proper location and area remains undisturbed. Disturbed areas must be stabilized. | Informal; report surface disturbances outside designated construction zones immediately. |
| Covered loads | Tarp all trucks hauling materials on or off site. | Informal; all loads prior to hauling must be covered. |
| Dust control | Reapply dust control measures as necessary to keep dust to a minimum at all times. | Informal; more frequent inspection is required during dry weather. |
| Erosion control materials | Maintain specified mulch cover. Correct eroded areas and reapply erosion control materials as necessary. Replace damaged materials and correct drainage problems. | Inspections by environmental personnel monthly and after storm events when storm water flows. |
| Preserving natural vegetation | Inspect flagged areas to ensure flagging is still in proper location and area remains undisturbed. Disturbed areas must be stabilized. | Informal; report disturbance to natural vegetation immediately. |
| Seeding/revegetation | Reseed areas that fail to germinate. Correct eroded areas by re-grading, reseeding, and installing erosion control materials, as necessary. | Inspect monthly during growing season until cover is considered 'finally stabilized' (vegetation density of 70% pre-disturbance levels), and after storm events. |
| Soil stabilizers/surfactants | Apply only according to manufacturer directions. Reapply as required. | Biweekly and after storm events in which surface water flows. Monthly if no rainfall has occurred. |
| Soil stockpiles | Inspect regularly, and stabilize areas that have eroded. | Informal and after storm events in which surface water flows. |
| Stabilized construction entrance | Restrict vehicle access to stabilized entrance. Upgrade if rock entrance is not working to prevent off-site tracking. | Informal |
| Surface roughening | Regrade any areas beginning to erode. Restrict vehicle access. Seed designated areas as soon as possible without smoothing surface | Biweekly and after storm events in which surface water flows. Monthly if no rainfall has occurred. |
| Erosion wattles | Inspect regularly and replace or re-stake as needed. Remove sediment when one half of the height of the wattle. | Inspect monthly and after storm events in which surface water flows. |
| Soil covering | To be used as an emergency cover for actively eroding areas such as soil stockpiles. Dispose of plastic properly when no longer needed. | As needed |
| Debris cleanup | Remove all litter and construction debris daily from the work area. | Informal |

| BMP Name | Recommended Maintenance /Repair | Inspection Requirements |
|---|---|---|
| **Runoff, Conveyance, and Treatment BMPs** | | |
| Sediment Basin | Sediment must be removed from the sediment basin/pond when the design capacity has been reduced by 50 percent. | Biweekly and after storm events in which surface water flows. Monthly if no rainfall has occurred. |
| Dispersion apron | Inspect to ensure underlying soils are not eroding. Remove sediment and repair eroded areas. | Inspect only if damage or sedimentation has occurred in adjacent diversion channel. |
| Silt fence | Repair damaged fencing immediately. Intercept concentrated flows and reroute. Remove sediment accumulations at 6 inches. Replace deteriorated fencing materials. Remove silt fence when upstream disturbed areas are stabilized. Properly dispose of used fencing. | Informal daily; formal bi-weekly and after storm events in which surface water flows. Monthly if no rainfall has occurred. |
| Straw bale barrier | Check for undercutting, end runs, and damaged bales. Remove accumulated sediment when one half the barrier height. Replace with check dams if straw bales prove to be inefficient. | Biweekly and after storm events in which surface water flows. Monthly if no rainfall has occurred |
| Diversion channel | Inspect to ensure structural integrity. Repair as needed. Remove sediment if present. | Biweekly and after storm events in which surface water flows. Monthly if no rainfall has occurred. |
| Road cleaning | Inspect road surface for transported sediment. Shovel or sweep sediment and dispose of properly. | Informal |

*Table B−2. Moab Site Routine Erosion and Sediment Control Inspection Form**

Inspector(s): _____ Date: _____

| BMP Designation | O.K. | Not O.K. | BMP Condition, Corrective Action, General Notes |
|---|---|---|---|
| Soil stability<br>Eroded areas?<br>Reapply surfactants? | | | |
| Check dams<br>Sediment?<br>Damage / Erosion?<br>Edges of dam? | | | |
| Detention ponds<br>Sediment?<br>Damage to slopes? | | | |
| Silt fence<br>Sediment?<br>Damage / Anchoring?<br>Concentrated flows? | | | |
| Straw bale barrier<br>Sediment?<br>Undercutting?<br>Damage / Anchoring? | | | |
| Moab Wash<br>Perimeter controls? | | | |
| Surface Runoff Basins<br>Sediment?<br>Structural integrity?<br>Adequate size? | | | |

Other concerns (from informal observations): _____

_____

I,_____, certify that the results of this inspection show that the Moab Site is in compliance with the SWP3 and this permit.

***Conduct routine inspections of disturbed area at least once every 14 days and before anticipated storm events. Any required maintenance must be reported to the on-site manager within 24 hours of the inspection.**

*Table B−3. Moab Site Monthly Environmental Erosion Control and Revegetation Inspection Form*

Inspector(s): _____Date: _____

Date/Time of last rainfall event: _____

| BMP Designation | O.K. | Not O.K. | BMP Condition, Corrective Action, General Notes |
|---|---|---|---|
| Erosion Control Materials<br>Mulch cover OK?<br>Eroded areas?<br>Damaged materials? | | | |
| Seeding/revegetation<br>Need reseeding?<br>Erosion areas?<br>Weed problems? | | | |
| Erosion Wattles<br>Damaged areas?<br>Restake needed?<br>Sediment buildup? | | | |

Other concerns: _____

_____

_____

_____

_____

_____

Notes: _____

_____

*Table B−4. Moab Site Post-Storm Erosion and Sediment Control Inspection Form**

Inspector(s): _____Date: _____

Date/Time/volume of last rainfall event:

_____

| BMP Designation | O.K. | Not O.K. | BMP Condition, Corrective Action, General Notes |
|---|---|---|---|
| Soil stability<br>Eroded areas?<br>Reapply surfactants? | | | |
| Check dams<br>Sediment?<br>Damage / Erosion?<br>Edges of dam? | | | |
| Berms<br>Any breaching?<br>Reconstruction Nec?<br>Operating as Needed? | | | |
| Detention ponds<br>Sediment?<br>Damage to slopes? | | | |
| Silt fence<br>Sediment?<br>Damage / Anchoring?<br>Concentrated flows? | | | |
| Straw bale barrier<br>Sediment?<br>Undercutting?<br>Damage / Anchoring? | | | |

Other concerns: _____

_____

I, _____, certify that the results of this inspection show that Moab Site is in compliance with this SWP3 and this permit.

***Must do inspection within 24-hours of end of storm that is 0.5 inches or greater and you must report the results, if maintenance is required, within 24 hours of the inspection to the on-site manager.**

End of current text

# Appendix C

# Examples of Best Management Practices

# Examples of Erosion and Sediment Control Measures

The provided examples may include specific application rates or references to specie lists that were appropriate to the sites or states for which the originating document was developed. However, prior to application or selection of species for revegetation at the Moab Site, application rates or specie identification would need to be adjusted based on area conditions and elevation.

These measures were obtained from two of many sources available on the Internet. The list below identifies the source as either CDOT, referencing the Colorado Department of Transportation, or, NV, for the State of Nevada Storm Water website. The Nevada examples also are identified by a footnote that refers to the Truckee Meadows Regional Storm Water Quality Management Program.

The Colorado Department of Transportation, Erosion Control and Storm Water Quality Guide is available at: http://www.dot.state.co.is/environmental/envWaterQual/wqms4asp.

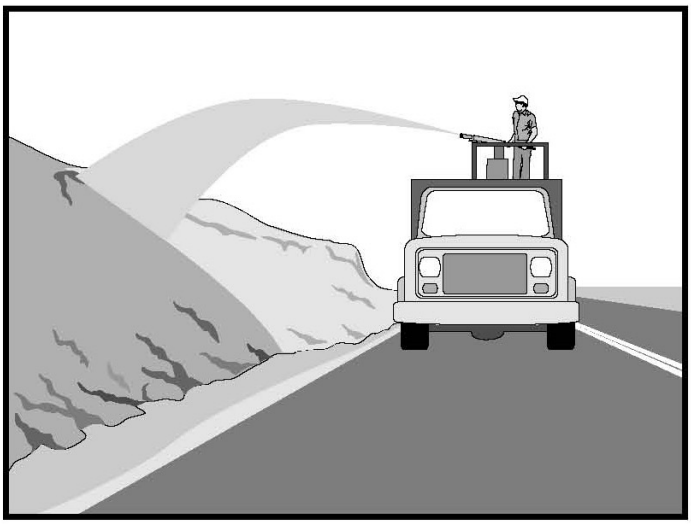
The *Truckee Meadows Construction Site Best Management Practices Handbook*, by Kennedy/Jenks Consultants, February 2003 is a comprehensive resource for information on erosion and sediment control methods that is used by t he State of Nevada and may be found on the Nevada State Storm Water website, http://www.cityofreno.com/gov/pub_works/stormwater/pdfs/TruckeeMeadowsBMP_rev01.pdf

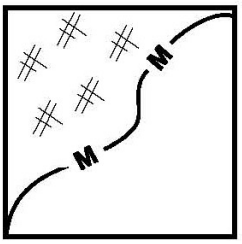
The following is a listing of the measures provided in this appendix.

Mulching (NV)
Mulch Tackifier (CDOT)
Soil Binders (NV)
Turf Reinforcement Mats (CDOT)
Erosion Control Blankets (CDOT)
Rolled Erosion Control Products (NV)
Erosion Logs (CDOT)
Erosion Bales (CDOT)
Wind Erosion Control (CDOT)
Riprap (NV)
Revegetation (NV)
Check Dams (NV)
Permanent Diversions (NV)
Storm Water Outlet Protection (NV)

End of current text

# MULCHING EC-3






MAP SYMBOL

Graphics used with permission of Caltrans

**Purpose:** To prevent erosion by protecting bare soil from rainfall, reducing runoff velocity, conserving moisture, and fostering plant growth. Mulches can be composed of organic materials, straw, wood chips, bark or other wood fibers, gravels, a variety of netting, or chemical stabilizers and they act to protect seeds from predators while reducing evaporation and insulating the soil.

**Application:**

- Applicable to all bare soil surfaces where construction activities will cease for 14 days or more and will not resume within 21 days.
- Provides a temporary cover and aids in stabilization measures.
- Mulching should immediately follow temporary and permanent seeding of an area.

**Limitations:**

- Additional control measures are necessary for the establishment of vegetation if the area is susceptible to erosion.
- Straw and wood mulch may have to be removed before soil stabilization or permanent seeding is to take place.
- Straw and wood mulch are prone to removal by runoff and wind.
- Wood fiber hydraulic mulches usually last only part of a growing season.
- A potential for introducing weed-seed and unwanted plant material exists.

- The use of grasses may cause a fire hazard and require regular maintenance.
- Not all soil conditions are appropriate.

**Standards and Specifications:**

- The type of mulch to be applied depends on soil type, site conditions, landscape requirements, and economics.
- Embankments and fill areas should be roughened before applying mulch.

Straw Mulch

- Used as a temporary or permanent surface cover on disturbed areas until vegetation can be established.
- Straw should be applied at a minimum rate of 4,000 lb/acre.
- Straw mulch can be applied to a slope by crimping, punch roller-type rollers, or track-walking.
- The area must be within 150 feet of a roadway if straw blowers are to be used in the application of the mulch,
- Do not place straw in lined drainage channels, on sidewalks, or on sound walls.
- Straw should be held into place on steep slopes or in small areas by plastic netting or jute.
- Apply straw mulch at a rate of 125 lb/acre if tackifier is to be used.
- Ensure that the mulch is weed free.

Wood Mulch and Shredded Wood

- Primarily used as a temporary ground cover around trees, shrubs, and landscaping.
- Is applicable as a covering for ornamental or revegetated plantings.
- Should be applied by hand.
- Distribute mulch as a layer 2-3 inches thick.

Green Material/Compost

- Mulch should be composted to kill weed seeds.
- Apply mulch evenly to a maximum thickness of 2 inches.
- Typically applied by hand.

Hydraulic Mulches made from recycled paper

- Composed of a mixture of recycled newsprint, magazines, or other paper waste products.
- Mulch should be mixed with seeds, fertilizer, and tackifier and can be applied on most sites.
- Erosion control effectiveness is limited by the short fiber length and lack of tackifier.
- Life span is less than that of the wood fiber mulches.

Hydraulic Mulches made from wood fiber

- Industry standard is composed of whole wood chips. Wood fiber mulch can also be made from lumber mill waste.
- Good for planting large areas quickly and economically.
- Provides limited erosion control (even with tackifier) when applied at high rates.
- Offers better wet-dry characteristics than paper mulch.

Hydraulic matrices (Bonded Fiber Matrix)

- Hydraulic slurries are a mix of wood or cellulose fiber held together by a chemical or mechanical bond.
- This mixture does not dissolve upon rewetting or contain any growth inhibiting factors.
- Application rates should range between 3,000 lbs/acre to 4,000 lbs/acre.
- Do not apply immediately before, during, or after rainfall. Allow 24 hours of drying before application.
- All mulch materials must be removed before working on the slopes.
- Weak spots should be covered to prevent soil erosion and to protect the soils.

**Inspection and Maintenance:**

- Inspect for failures and loss of mulch during the wet season.
- Replace lost mulch immediately.

# EC 3: Mulch Tackifier

**Description**

An organic soluble powder adhesive used in the form of a water slurry to adhere native hay, straw, hydromulch, or seed to a surface and together. Derivative of plant material phyllium or Guar.

**Applications**

- Used in combination with a native forage material for mulching applications.
- Used in combination with seed to adhere seed to soil.
- Used to adhere wood cellulose material (hydro mulch) to surface.
- Used to cover disturbances as temporary cover for wind erosion.

**Limitations**

- Temporary measure to hold mulch material until native seeding is established.
- Product is water-soluble and must be reapplied 6-12 months after initial application if plants have not stabilized soils.
- Do not apply during precipitation event or over snow.
- Do not apply where in areas of concentrated flow.

**Design Guidelines**

Design mixture as shown or as recommended by the manufacturer:

- 150-200 lbs of organic mulch tackifier per acre.
- 1,000 gallons of water per acre.
- 350 lbs of wood cellulose material per acre.

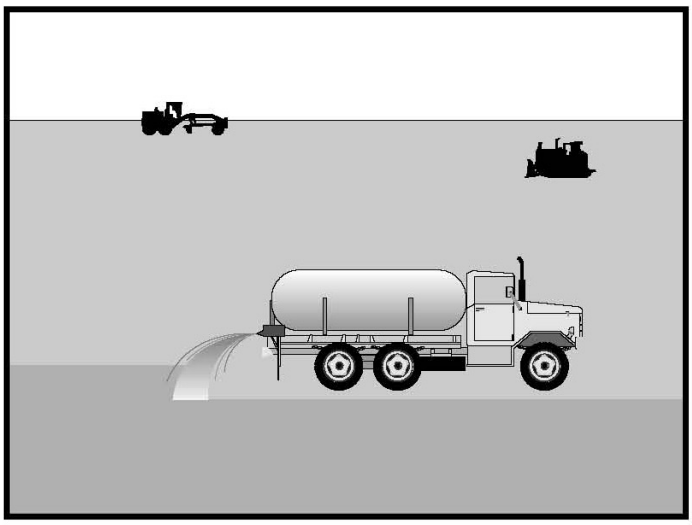
**Installation**

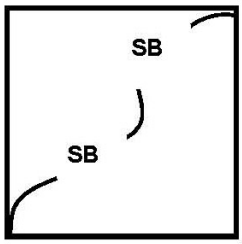
- Apply within 4 hours of mulch application.
- Always apply in a liquid state.
- Can be applied in combination with organic fertilizers and humates.

**Maintenance and Inspection**

- Mulch movement indicates poor application and product mixture.
- Proper application will bond mulch material together and to soil.
- Inspect by touching mulch surface to determine if adhesion has occurred.

# SOIL BINDERS EC-4






MAP SYMBOL

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**Purpose:** To provide temporary stabilization of disturbed soils.

**Application:**

- Locations where other methods such as temporary or permanent seeding of vegetation can't be applied.
- Used in combination with vegetative or perimeter practices to enhance erosion and sediment control.

**Limitations:**

- May limit infiltration and increase runoff.
- Overuse may adversely impact water quality.
- Chemical stabilizers are expensive compared to vegetative practices.
- Soil binders are only temporary and therefore need to be reapplied.
- Some binders need at least 24 hours to become fully effective.
- Heavy rainfall events may cause spot failures.
- Soil binders are weakened by pedestrian or construction traffic.
- Soil surfaces comprised of compacted silts and clays may be impenetrable to soil binders.
- Low temperatures may not allow soil binders to cure.
- Some soil binders do not perform well in climates with low relative humidity.

# SOIL BINDERS EC-4

**Standards and Specifications:**

- Soil binders must be non-toxic to plants and animals, easy to apply, easy to maintain, economical, and should not stain paved surfaces.
- Spray should not reach sidewalks, lined drainage channels, or existing vegetation.

Types of soil binders:

- Copolymer – Provides long-term soil stabilization (1-2 years) and is compatible with existing vegetation. However, it is relatively costly and 80 – 100 gallons/acre is the suggested application rate.
- Lignin sulfonate – Good for short- to medium-term soil stabilization in low traffic areas. Effective in dry climates and should be applied in a 1-2 inch thick layer on loosened surfaces.
- Psyllium/Guar – Good for short-term application. They are low cost but may adversely affect vegetation.
- Starch, Rosin and Bonded Fiber Matrix (EC-3) can also be used.

Factors to consider when choosing a soil binder:

- Consider where the soil binder will be applied.
- Soil type and frequency of application.
- Follow the manufacturer's recommended application rates and procedures.
- Roughen embankments and fill areas prior to application of soil binders.
- Do not apply soil binders during or immediately after rainfall.
- Do not apply soil binders to frozen soils or areas with standing water or during rainy conditions or when the temperature is less than 40°F.
- Allow 24 hours for soil binders to cure.

The application of liquid agents requires:

- Pre-wetting of the ground surface.
- Overlapping solution 6 to 12 inches.
- Curing for a minimum of 24 hours.
- Apply a second treatment when first treatment becomes 50 percent ineffective.
- Re-wetting the chemicals with water to reactivate them in dry climates.

# SOIL BINDERS EC-4

**Inspection and Maintenance:**

- Inspect regularly areas that have been chemically stabilized.
- Inspect daily high traffic areas while lower trafficked areas need only weekly inspection.
- Reapply stabilizers if needed.

# EC 6: Turf Reinforcement Mats (TRM)

**Description**

A rolled permanent erosion control product composed of UV-stabilized, non-degradable, synthetic materials (which may include an organic, biodegradable fiber component) processed into a three-dimensional matrix.

**Applications**

- Used in ditches, swales, channels, and slopes where design discharges exert velocities and shear stresses that exceed the limits of mature, natural vegetation to prevent erosion.
- Used in transition areas before and after hard armor (i.e., riprap, concrete, asphalt etc.) to provide for stable and non-erosive transition.

**Limitations**

- In an unvegetated state, velocities should not exceed 14 ft/sec maximum or the limitations provided by the manufacturer.
- In a vegetated state, velocities should not exceed 25 ft/sec maximum or the limitations provided by the manufacturer.
- Maximum slope is dictated by the soil stability and above referenced limited velocity and shear stress limitations.
- Soils must be conducive to the establishment of vegetation.

**Design Guidelines**

- TRM may be installed as either an on-the-surface or soil-loaded system (for surface, see Figure EC 5.1; for soil-loaded, see Figure EC 5.2).
- TRM shall be unrolled in direction of flow with edges overlapped a minimum of 4 inches and end of rolls overlapped a minimum of 6 inches.
- Anchors for the TRM should be per manufacturer's recommendations for the particular TRM application and no less than two per square yard.

- TRM shall extend 2 feet minimum above the design maximum flow line in ditches, swales, and channels.
- Unless the TRM is anchored by a hard armor application, the leading edge of the TRM shall be buried and anchored per Figure EC 5.3.
- Soil-loaded system shall have no more than 1.5 to 2 inches of soil applied on the TRM.

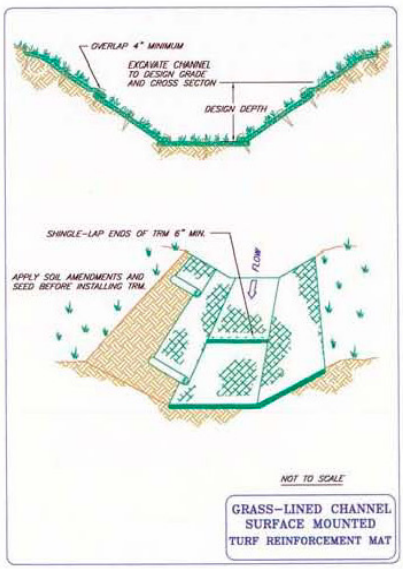



FIGURE EC 6.1
TRM in Ditch Application (CDOT[18])

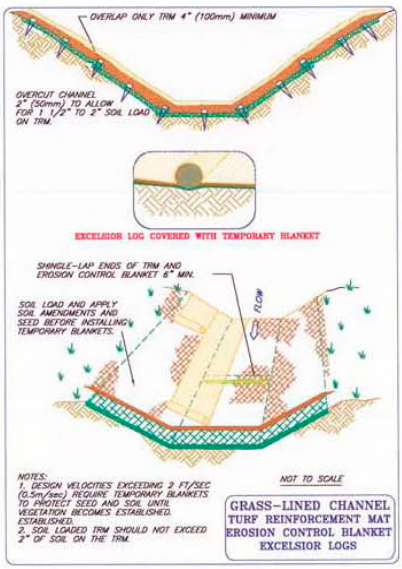



FIGURE EC 6.2
TRM in Ditch Application with Mesh/Burlap Socks (CDOT[18])

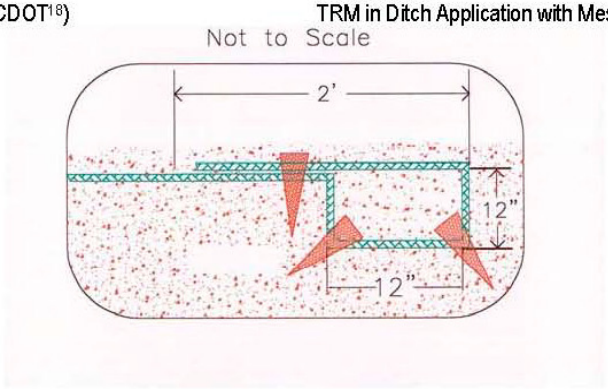



FIGURE EC 6.3
Trenching of TRM (CDOT[18])

**Installation**

- All vegetation, roots, rocks, and other objectionable material shall be removed and disposed of so as not to create loss of soil contact by the TRM when installed.
- If TRM is not soil loaded, apply seed, soil amendments, etc. before installing TRM.
- If the TRM is soil loaded, follow installation of the TRM with seed and soil amendments. After soil loading the TRM, install an erosion control blanket as shown in Figure EC 6.2. Install the erosion control blankets in accordance with the manufacturers recommendation. General guidelines are included in BMP EC 5: Erosion Control Blankets.
- If mesh/burlap socks are used in conjunction with the soil-loaded system, they should be placed before the erosion control blanket and after soil loading. The erosion control blankets should be unrolled and closely stapled to the upper edge of the mesh/burlap sock; unrolled tightly over the mesh/burlap sock and stapled closely at the lower edge; and then continuously unrolled (see Figure EC 6.3).

**Maintenance and Inspection**

- Re-anchor loosened matting and replace missing matting and staples as required.
- Inspection shall be performed periodically especially after a storm event that results in runoff, and any required repairs or maintenance shall be executed immediately.

# EC 5: Erosion Control Blankets

**Description** Organic or synthetic blankets installed on steep lopes or channels to prevent erosion until final vegetation is established.

**Applications**

- Used to control erosion and promote the establishment of vegetation.
- Used to protect channels against erosion from concentrated runoff. Also refer to EC 6, Turf Reinforcement Mats, for additional types of erosion protection for areas with concentrated runoff.
- Used as a temporary feature.

## Limitations

- Blankets used on slopes should be biodegradable, or photodegradable, non-toxic to vegetation or germination of seed, and non-toxic or injurious to humans.
- Do not use on slopes where vegetation is already established.
- Use on slopes 2:1 or steeper. Also use in locations with 3:1 slopes facing south or west. Product must be reapplied 6-12 months after initial application. If used in conjunction with seeding, reapply every 6-12 months until vegetation is established.

## Design Guidelines

- For slope applications, selection of the appropriate material will depend on the amount of runoff, steepness of the slope, flow velocities, cost, ease of installation, type of soils, shear stress, and past experience.
- For channel applications, selection will be based mainly on shear stress. Refer to EC 6 for additional selections.
- Table EC 5.1 indicates dome recommended criteria for the selection of erosion control blankets.

**TABLE EC 5.1**
Seeding Season

| Condition | Blanket Type |
|---|---|
| Slopes 2:1 or Steeper | Straw Blanket<br>Straw/coconut blanket<br>Synthetic Blanket<br>Wood Fiber Blanket (excelsior) |
| Erosive soil (sand) or slopes receiving sheet flow from roadway surface runoff | Straw Blanket<br>Straw/coconut blanket<br>Synthetic blanket |

## Materials

- Combination Blankets: Consists of a photodegradable plastic netting which covers, and is entwined, in a natural organic or man-made mulching material. The mulching material can be wood-fiber, excelsior, straw, coconut fiber, manmade fiber, or a combination of the same. Some existing combinations are 100% coconut fiber, or 70% agricultural straw and 30% coconut fiber, or 100% agricultural straw.
- Jute mesh: Consists of a mat lining woven of undyed and unbleached jute yarn. Varies from 1/8″ to ¼″ in diameter. The mat weighs approximately 0.80 lbs per square yard, with openings about 3/8″ by ¾″. It can be used with or without straw underlay.
- Soil reinforcement mats: Formed by three-dimensional structures of entangled nylon monofilaments, melt-bonded at their intersections. These mats must be capable of maintaining its shape, and are generally highly resistant to environmental and ultraviolet degradation.

## Installation

- Areas where the blanket is to be used shall be properly prepared, fertilized, and seeded before the blanket is placed.
- Installation of the blankets shall be in accordance with the manufacturer's recommendations.
- The blanket shall be placed smoothly but loosely on the soil surface without stretching.
- Pins and staples shall be made of wire 0.162 inch or larger in diameter. "U" shaped staples shall have legs 8" long, and a 1" crown. "T" shaped pins shall have a minimum length of 8". The bar of the "T" shall be at least 4" long. Triangular survey stakes can also be used (see Figure 5.1).
- Staples shall be inserted in a pattern according to the manufacturer's recommendation.
- The upslope end of the blanket shall be buried in a trench 6" by 6" deep beyond the crest of the slope to avoid undercutting (see Figure EC 5.2).
- For slope applications, there shall be at least a 6" overlap wherever one roll of blanket ends and another begins, with the uphill blanket placed on top of the downhill blanket (see Figure EC 5.2).
- There shall be at least a 4" overlap wherever two widths of blanket are applied side by side (see Figure EC 5.2).
- In channels, the blanket shall be buried at terminal ends and every 35' in a trench 6" deep by 6" wide. Before backfilling, staples shall be placed across the width of the trench spaced at 6" on center in a zigzag pattern. The trench shall then be backfilled to grade and compacted by foot tamping.

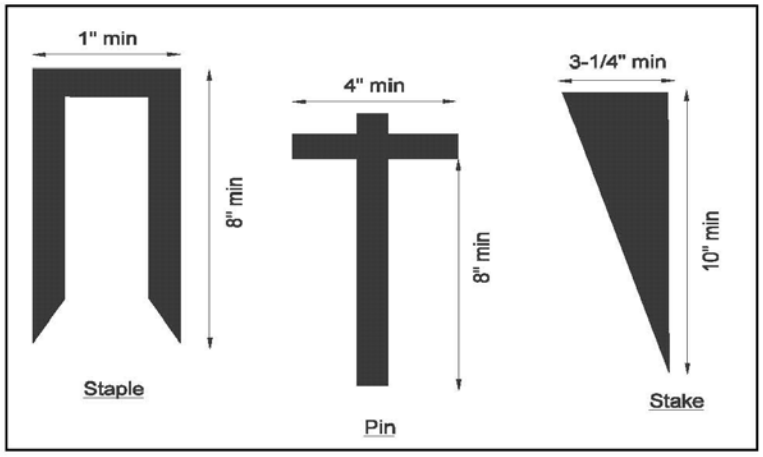



**FIGURE EC 5.1**
Erosion Control Blanket Anchors

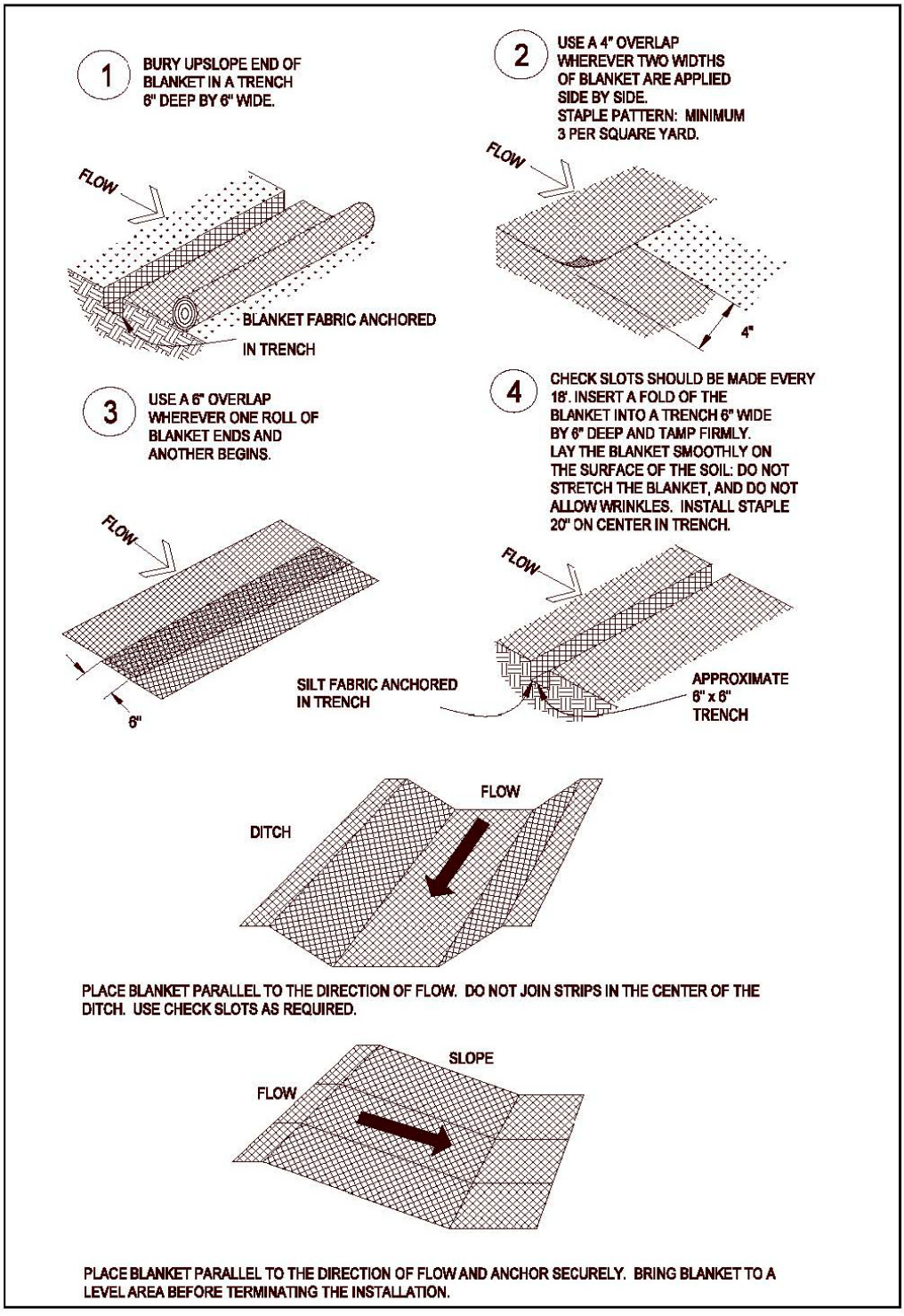
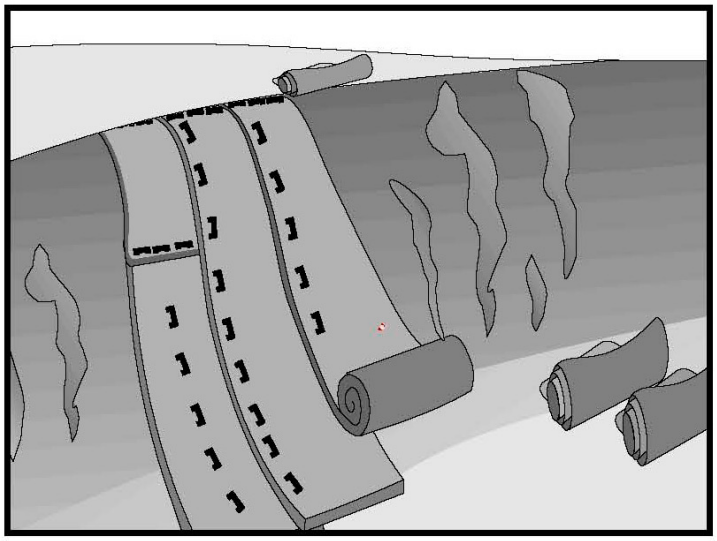


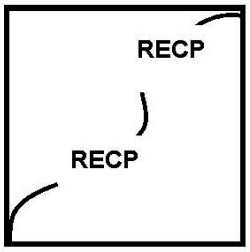

**FIGURE EC 5.2**
Erosion Control Blanket Installation

**Maintenance and Inspection**

- Re-anchor loosened matting and replace missing matting and staples as required.
- Inspection shall be performed periodically especially after a storm event that results in runoff, and any required repairs or maintenance shall be executed immediately.

# ROLLED EROSION CONTROL PRODUCTS EC-6






MAP SYMBOL

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**Purpose:** To protect soils from wind and water and to stabilize disturbed soil areas through the application of geotextiles, plastic covers, erosion control blankets, cellular confinement systems or turf reinforcement mats.

**Application:**

- Effective on steep slopes (3H:1V or greater) with high erosion potentials, slopes that are adjacent to streams or wetlands, on disturbed soils that are slow to establish vegetative cover, and on slopes where mulch must be anchored. Can also be applied in stream channels where flow velocities exceed 3.3 ft/sec.

**Limitations:**

- RECPs are not appropriate for sites that will be mowed or that contain rocky surfaces.
- Erosion control blankets and geotextiles are rarely used as a temporary control measure.
- Erosion control blankets and geotextiles tend to be more expensive than other erosion control methods due labor costs and material expenses.
- Erosion control blankets and geotextiles should not be used in high wind areas.
- Turf reinforcement mats (TRMs) should only be used with irrigation or where there is surface hydrology (i.e. wetlands).

- Plastic sheeting is not degradable, can be easily torn, and must be disposed of at a landfill. It also results in 100 percent runoff, which increases the potential for erosion and downstream flooding.

**Standards and Specifications:**

- Factors to consider when choosing an erosion control blanket include cost, effectiveness, acceptability, vegetation enhancement, installation, and operation and maintenance.
- Geotextiles should have a minimum thickness of 0.6 inches and a minimum width of 12 feet. They should be secured in place with wire staples or sandbags.
- Polyethylene sheeting of 6-mil minimum thickness should be anchored by sandbags placed a maximum distance of 10 feet apart. Seams should be held down by tape or weights across their entire length. All seams should be overlapped at least 12-24 inches.
- Turf reinforcement mats are a three dimensional matrix of interwoven layers of polypropylene, nylon, and polyvinyl chloride netting. They allow for soil filling and retention as well as aiding in the enhancement of vegetative root and stem development.
- Turf reinforcement mats have high shear strengths, are resistant to ultraviolet light, and are inert to the chemicals in soils.
- Straw, coconut, straw/coconut, or Excelsior blankets are used as erosion control mats.
- All rocks, vegetation, clods, and debris should be removed from the site before installing erosion control mats to allow for direct contact with soil.
- Seed the area before installing erosion control blankets.
- To anchor mats, u-shaped wire staples, triangular wooden stakes, or metal geotextile stake pins can be used.
- Staples should be made of steel wire. Wire staples should be a minimum of 11 gauge.
- Metal stake pins should have steel washers at the head of the pins.
- All anchors should be 6-18 inches long.

<u>Steps to install erosion control blankets on slopes:</u>

- At the top of the slope, install a trench 6 inches deep by 6 inches wide to anchor the blanket and then backfill the trench.
- Follow the direction of water and unroll the blanket (downslope).
- Parallel rolls should be overlapped by 2 inches and stapled every 3 feet.

- Splice the blankets by laying them over each other with a 6-inch overlap.
- Keep the blankets in direct contact with the soil. Do not stretch them.

To anchor the blanket, install staples:

- Steep slopes (2H:1V and steeper) – minimum of 2 staples/yd$^2$
- Moderate slopes (2H:1V and flatter) – 1½ staples/yd$^2$
- Gentle slopes require a minimum of 1 staple/yd$^2$

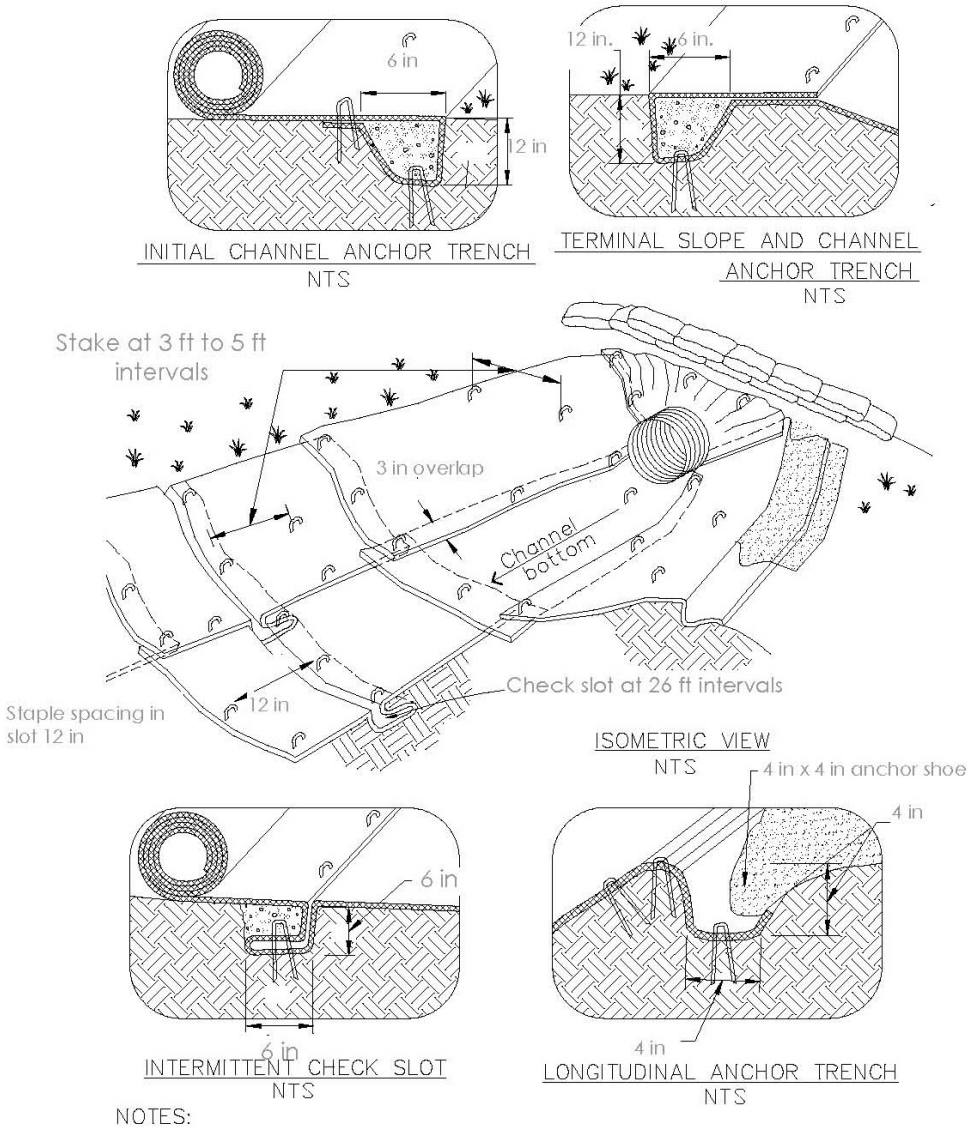
Steps to install erosion control blankets in channels:

- Anchor trench should be 12 inches deep and 6 inches wide across the channel at the lower end of the project area.
- Dig 6-inch deep and 6-inch wide intermittent check slots across the channel at a spacing of 25 to 30 feet.
- To bury the edge of the matting, dig 4-inch deep and 4-inch wide anchor slots longitudinally along the channel.
- Place the initial roll in the center of the channel at the downstream end. Secure it every 12 inches. Note that the matting will be upside down initially.
- Repeat the previous step using the adjacent rolls and creating a 3-inch overlap of blankets. Be sure to anchor the ends of the mats down securely every 12 inches.
- Unroll the center mat upstream and follow with the others maintaining the 3-inch overlap.
- Secure all rolls snugly into transverse check slots by laying the mat into the slot, folding the mat back on itself, installing anchors, filling with backfill and compacting the soil.

**Inspection and Maintenance:**

- Blankets should be inspected after installation and periodically during construction activities.
- Before and after significant storm events, the blankets and mats should be inspected for erosion and undermining.
- Repair damages and failures immediately.
- Repair the slope or channel before reinstalling blankets if washouts or breakages have occurred.

# ROLLED EROSION CONTROL PRODUCTS EC-6




NOTES:
1. Check slots to be constructed per manufacturers specifications.
2. Staking or stapling layout per manufacturers specifications.
3. Install per manufacturer's recommendations

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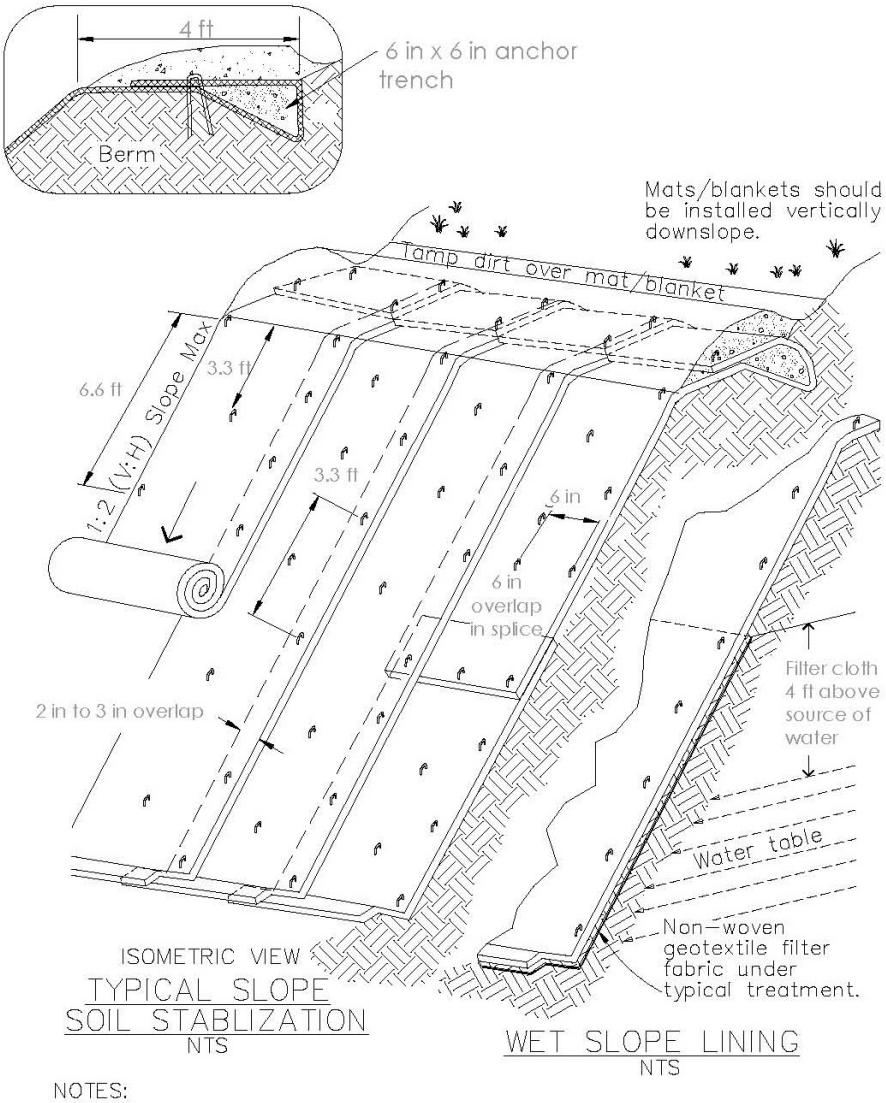
# ROLLED EROSION CONTROL PRODUCTS EC-6




NOTES:

1. Slope surface shall be free of rocks, clods, sticks and grass. Mats/blankets shall have good soil contact.
2. Lay blankets loosely and stake or staple to maintain direct contact with the soil. Do not stretch.
3. Install per manufacturer's recommendations

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# SC 2: Erosion Logs

**Description**

Erosion logs filled with rock or other filter material used for erosion and sediment control.

**Applications**

- Used upstream of curb inlets to filter sediment laden runoff. Logs of various length can be accommodated with multiple logs installed in series. Typical placement of a log is upstream of an inlet, in the gutter flow line, and also at the entrance of an inlet.
- Used as check dams in ditches and swales for erosion control until vegetative cover is established.
- Used as a temporary feature.

**Limitations**

- Logs are manufactured BMPs. Refer to the manufacturer for guidelines on limitations.
- Do not use in ditches and swales with continuous flow.

**Material**

- Several types of logs exist. A "gravel" log is typically a cylindrical shaped filter with ¼ inch mesh or burlap filter cover filled with ¾ inch gravel. Refer to the manufacturer for specific material specifications.

**Installation**

General installation guidelines are provided, however, refer to the manufacturer for specific installation requirements.

***Installation for Check Dam Applications***

- When using as a check dam, it should be placed in straight sections to minimize the potential for erosion in the channel bend.

***Installation for Curb Inlet Protection (Upstream of inlet)***

- Logs will be used upgradient of inlet perpendicular to and flush with the curb.
- The maximum height of the curb log should be less than the top of the curb opening. This is to allow overflows to occur during large rainfall events even though sediment-laden runoff will enter the storm drainage system.
- No less than two 10-inch diameter logs must be used in sequence, spaced no more than five feet apart, upgradient of inlet. No less than six logs shall be used if the 4–inch log is chosen.
- Incline at 30 degrees from perpendicular, opposite the direction of flow.

***Installation for Curb Inlet Protection (Entrance of inlet)***

- Identify curb opening dimensions to determine how many logs are required.
- Place the log(s) end-to-end along the curb inlet opening.
- Angle the ends of the log(s) towards the curb inlet opening.

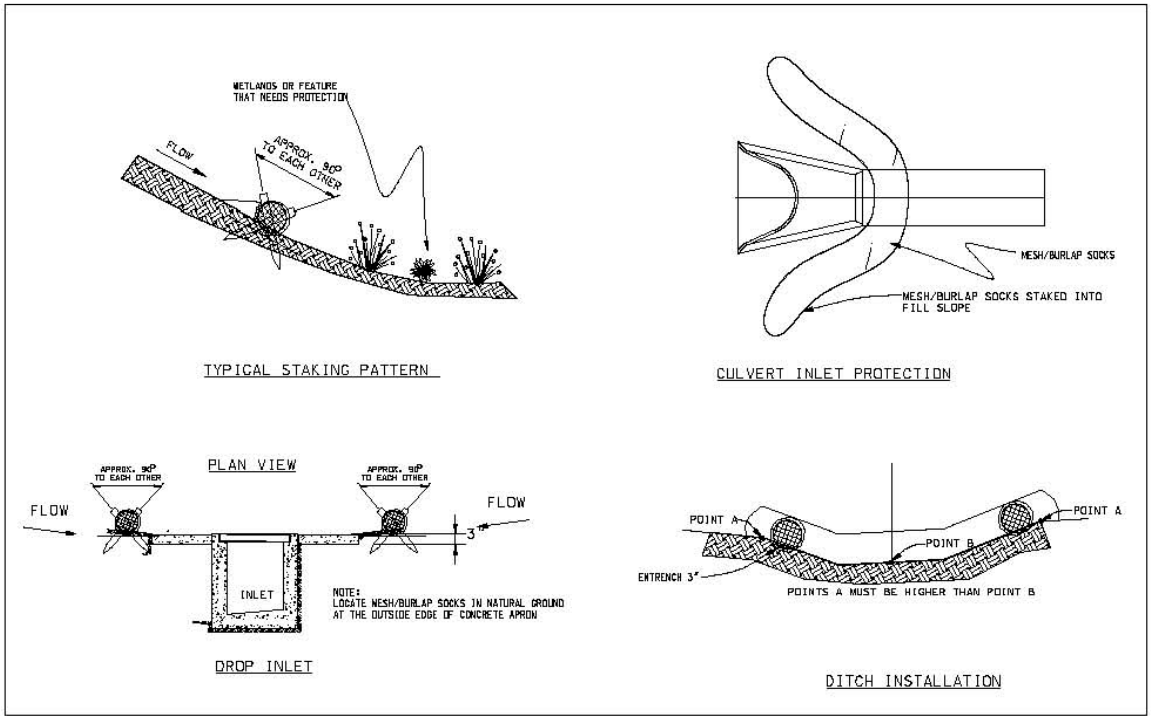


**FIGURE SC 2.1**
Applications for Erosion Logs (CDOT[18])

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**Maintenance and Inspection**

- Inspect logs daily for cuts, abrasions, and proper installation, replace or reposition daily. Remove sediment and dispose in a proper manner.
- Discontinue use if logs create a traffic hazard.

# SC 1: Erosion Bale

**Description**

A temporary sediment barrier consisting of a row of entrenched and anchored straw, or hay bales.

**Applications**

- Used as temporary sediment barriers and filters along the toe of fills or around inlets.

**Limitations**

- Do not use along toe of fills where the size of the drainage area is greater than one-quarter acre per 100 feet of barrier length; maximum slope length and gradient behind the barrier is 100 feet and 50 percent (2:1), respectively.
- Do not use where effectiveness is required for more than 3 months. Useful life of erosion bale is approximately 1 year; the bales may have to be replaced one or more times during construction.
- Under no circumstances should erosion bale be constructed in flowing streams or in swales where flows are likely to exceed 1 cfs, and where the contributing drainage area is greater than 1 acre.
- Not to be used where the control of sediment is critical; in high-risk areas; in areas where they cannot be entrenched as required and firmly anchored; and areas where ponded water could flow onto the roadway.

**Installation**

- The erosion bale must be entrenched and backfilled. A trench should be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 4 inches. After the bales are staked, the excavated soil must be backfilled against the barrier. Backfill soil should conform to the ground level on the downhill side and should be built up to 4 inches against the uphill side of the barrier.
- Each bale must be securely anchored by at least two wooden stakes driven toward the previously laid bale to force the bales together. Stakes should be driven into the ground a minimum of 1 foot to securely anchor

the bales. Stakes should have a minimum diameter or cross section of 2 inches. Reinforcing bars shall not be used in place of the wooden stake.

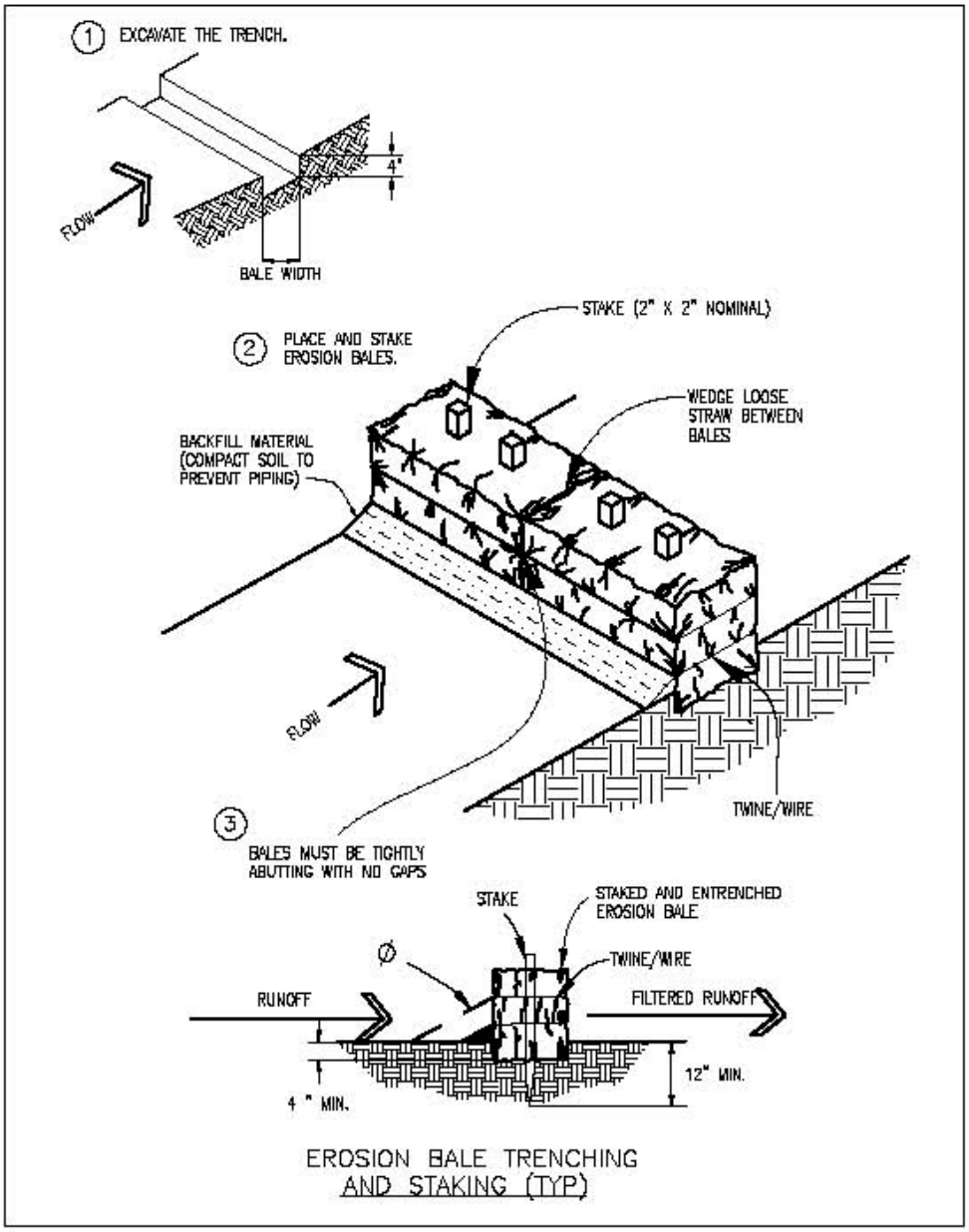


**FIGURE SC 1.1**
Erosion Bale Installation (CDOT[18])

- All bales must be either wire-bound or string-tied, and they should be installed so that bindings are oriented around the sides rather than along

the tops and bottoms of the bales (in order to prevent deterioration of bindings).

- The gaps between bales should be filled by wedging with straw to prevent water from escaping between the bales. The main consideration is to obtain tight joints. Erosion bales will not filter sediment or pond water if the water is allowed to flow between, around, or under the bales. Loose straw or hay scattered over the area immediately uphill from an erosion bale barrier tends to increase barrier efficiency.
- Along toe of fills, install the erosion bales along a level contour and leave enough area behind the barrier for runoff to pond and sediment to settle. A minimum distance of 5 feet from toe of the fill is recommended.

**Maintenance and Inspection**

- Erosion bales deteriorate quickly and, therefore, inspections during construction should be frequent. Repair or replacement should be made promptly as needed.
- Erosion bales must be removed when they have served their usefulness.
- Trenches where erosion bales were located should be graded and stabilized.
- Sediment accumulation against the erosion bale barrier shall be removed when it reaches half the exposed bale height. Sediments removed must be properly disposed.
- Replace erosion bales as necessary but at a minimum of once each year.

# GP 5: Wind Erosion Control

**Description** Practices, such as applying water or dust palliatives, to be implemented during construction operations to prevent wind erosion from exposed soil surfaces.

**Applications** These practices are limited to exposed soil where wind erosion is expected.

**Limitations** The effectiveness of this application can be limited by soil, temperature, and wind velocity.

**Standards and Specifications**

- Irrigation practices can be applied to a project site until the soil is moist and can be repeated as necessary. However, the soil shall not be over-saturated causing runoff to flow from the project site. The distribution system shall be equipped with a proper spray system to ensure even water distribution. When a distribution system is unavailable, at least one mobile unit shall be available at all times to apply water or a dust palliative to the project site. All non-potable tanks, pipes, and other conveyances shall be marked "non-potable water-do not drink."
- Seeding, mulching, soil binder, and grading techniques are also temporary methods to prevent wind erosion. Refer to BMPs EC 1, EC2, EC 4, and EC 13.

**Maintenance and Inspection**

- Inspect protected areas routinely for adequate protection and signs of degradation.
- Perform routine spot-checks to ensure wind erosion control techniques are properly implemented.

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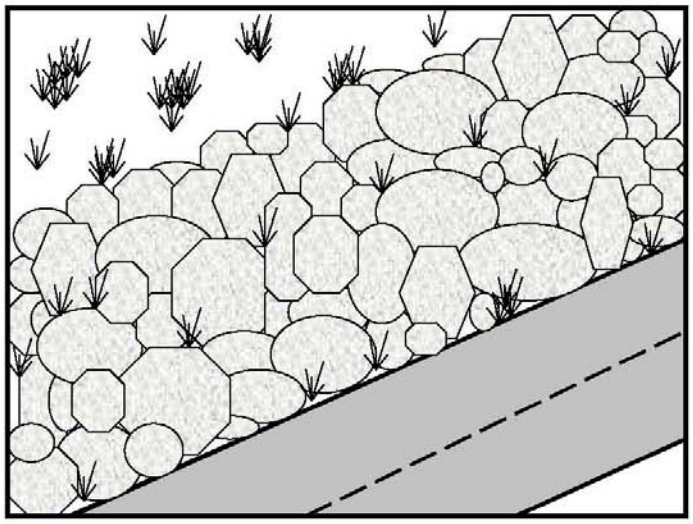
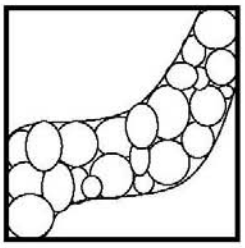
# RIPRAP EC-7





MAP SYMBOL

Graphics produced by Kennedy/Jenks Consultants

**Purpose:** To stabilize and to protect soil from erosion in areas of concentrated runoff.

**Application:**

- Used on cut-and-fill slopes, channel side slopes, channel bottoms, inlets and outlets of culverts and slope drains, and streambanks.

**Limitations:**

- Riprap is not allowed for use as an erosion or sediment control on disturbed slopes within the City of Sparks.
- Slopes greater than 2H:1V may lose riprap.
- Measures should be taken to minimize erosion and excess turbidity in flowing streams during construction.

**Standards and Specifications:**

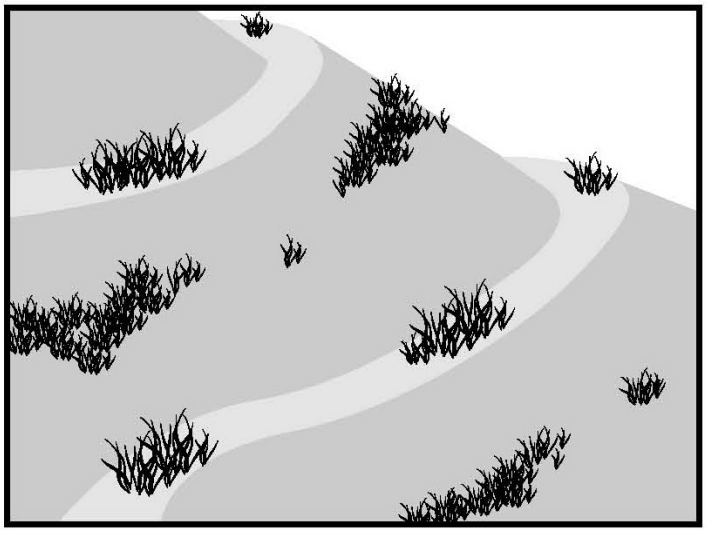
- Use a well-graded mixture of rock sizes.
- Use durable stone that won't quickly decompose from freeze/thaw cycles (i.e. granite).
- Riprap layers should be twice as thick as the maximum stone diameter.
- Use a filter cloth material or a layer of gravel as a filter between the riprap and the underlying soil surface.

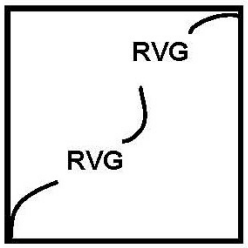
- Riprap should extend as high as the maximum flow depth in channels or streams (minimum of 4 feet) or to a height where vegetation will be satisfactory to control erosion.
- On curves, riprap should extend through the curve to five times the upstream and downstream curve endpoints.
- Riprap size depends upon site-specific conditions.

**Inspection and Maintenance:**

- Inspect annually and after major storms.
- Damaged riprap should be repaired immediately.
- Keep channel clear of obstructions such as trees and sediment bars.

# REVEGETATION EC-8






MAP SYMBOL

Graphics used with permission of Caltrans

**Purpose:** To stabilize soils and slopes from raindrop impact and erosion, conserve soil moisture, decrease runoff, increase infiltration, and to provide wildlife habitat.

**Application:**

- Can be applied on slopes, adjacent to waterways, as buffer strips and landscape corridors, on stream banks and in cut and fill areas.

**Limitations:**

- Irrigation during dry weather may be required.
- Additional erosion control methods may be required if the site is prone to erosion.
- Sod is much more expensive than seeding.

**Standards and Specifications:**

- With the exception of frozen ground conditions, permanent revegetation must be seeded or planted no later than 21 days after final grading.
- Consider climate, soils, and topography when choosing the appropriate vegetation and seed mixes for installation. They should be developed based on site-specific conditions and soil testing may be required.
- Hydroseeding is a cost effect method of applying seed mixes.
- A combination of seed species should be used when the objective is to re-establish native species that require little to no irrigation.

- Refer to the attached list of suitable species for the Truckee Meadows.
- All seeding rates must be based on Pure Live Seed.
- Crested wheatgrass should never be the dominant species in a seed mix.
- Local climatic conditions and plant species will determine when to install vegetation.
- Increase revegetation success by roughening soils (EC-2) prior to seeding then applying mulch (EC-3) with a tackifier.
- Normally, unless slow release, fertilizers should not be applied.
- After seeding, grasses and legumes should emerge between 4-28 days.
- Plants should have a uniform density and should be well intermixed.
- Final stabilization requires that perennial vegetation has been established with a density of 70 percent of the native background cover.

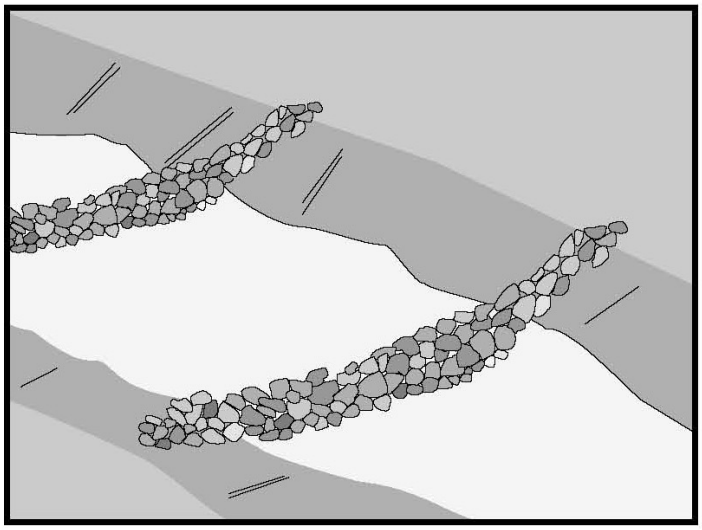
Sod

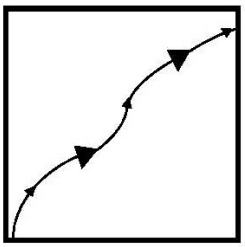
- Sod can provide immediate cover for critical areas.
- Sod should be free of noxious weeds, diseases, and insects.
- Strips of sod with a thickness between ½-inch and 2 inches should be laid perpendicular to the direction of runoff flows and should be staggered in a brick-like pattern.
- Sod should be secured with stakes when the slope is steeper than 3H:1V.
- The harvesting, delivery, and installation of sod should occur within 36 hours.
- Avoid installing sod on gravel or non-soil surfaces.
- Avoid installation during unusually hot, wet, or cold weather and do not mow the sod for 2-3 weeks after installation.

**Inspection and Maintenance:**

- Irrigation may be required until new vegetation has been firmly established.
- Seeded areas should be examined for failures. If failures have occurred the area should be reseeded, amended if necessary, and mulched during the planting season.
- Soil tests should be conducted to determine if soil inoculants, amendments or fertilizers are necessary.
- Water sod regularly and uniformly.

# CHECK DAMS RC-3





MAP SYMBOL

Graphics used with permission of Caltrans

**Purpose:** To reduce erosion in channels, swales and ditches caused by high flow velocities through the installation of temporary dams constructed of rocks or gravel/sand bags.

**Application:**

- Used in small open channels draining 10 acres or less.
- Used in steep channels when runoff velocities exceed 5 feet/second.
- Used when establishing grass linings in channels or drainage ditches.

**Limitations:**

- Do not use in live streams.
- Do not use in channels draining areas greater than 10 acres.
- Do not construct a check dam with silt fencing or straw bales.
- Check dams should not be used as primary sediment-trapping devices.
- Extensive maintenance may be required following high flow events.

# CHECK DAMS RC-3

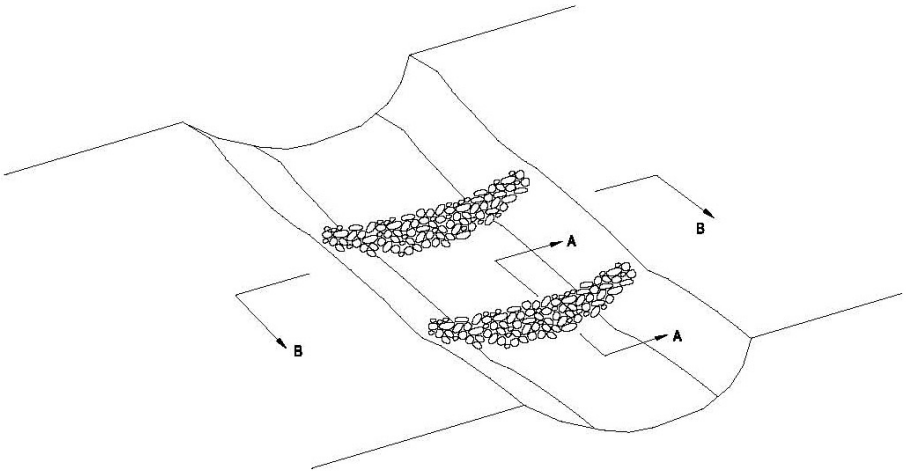
**Standards and Specifications:**

- Place check dams at a distance and height to allow small pools to form behind them.
- Space the dams at regular intervals based upon soil types and slope gradients. The first check dam should be installed approximately 30 feet upstream of the outfall device.
- Design a check dam to pass a 2-year, 24-hour storm without causing damage to the dam or any upstream flooding.
- Rock diameters should range between 8 and 12 inches.
- The maximum height of a check dam is 4 feet from the upstream toe to the crest and the center of the dam.
- The crest and the center of the dam should be 6 inches lower than the edges.
- Install (keyed) dam materials at least 6 inches into the sides and bottom of the channel.
- Rocks should not be dumped in the construction of the check dam. Rocks should be placed individually by hand or by mechanical methods.
- The downstream toe of the dam should be met by the backwater from the downstream check dam if multiple check dams are installed.
- Check dams should be removed once vegetation has been established in a channel. Check dams may be left in place if the check dam is designed as a permanent structure in accordance with local drainage policies.
- From October to May, do not allow water to pond behind check dams for more than 7 days.

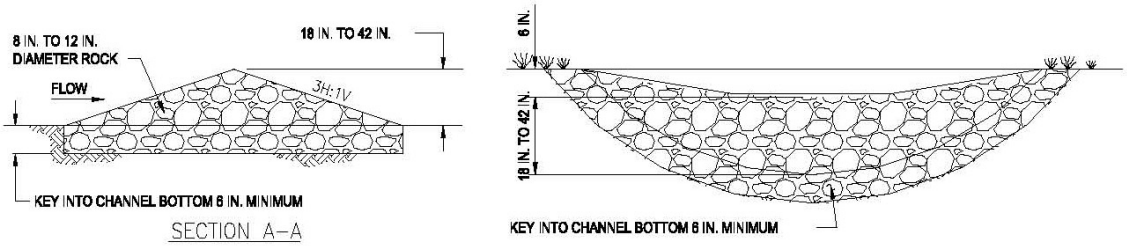
**Inspection and Maintenance:**

- Inspect regularly and after each runoff event for sediment buildup and signs of erosion under or around the dam.
- Replace loose material.
- Remove accumulated sediments when it reaches one third of the check dam height.
- Remove accumulated sediments prior to performing soil stabilization or permanent seeding practices.
- Remove check dam and accumulated sediments when dams are no longer needed.
- Dispose of accumulated sediments properly.

# CHECK DAMS RC-3



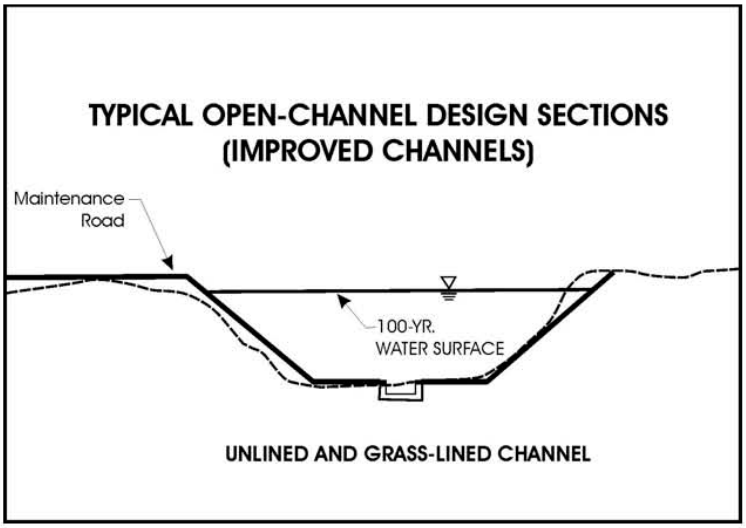

TEMPORARY CHECK DAM
(ADAPTED FROM CALTRANS)




ROCK CHECK DAM
NOT TO SCALE

Graphics adapted from Caltrans.

# PERMANENT DIVERSIONS RC-1




Graphic produced by Kennedy/Jenks Consultants

**Purpose:** To design permanent facilities to collect stormwater runoff and/or stream flow and convey it away from disturbed ground to an appropriate outlet or downstream drainage channel.

**Application:**

- To decrease the threat of runoff from upstream watersheds that could pose a hazard resulting in property damage or erosion.
- To protect upland slopes by reducing slope lengths and minimizing erosion and soil loss.
- To reduce runoff velocities and increase stability by reducing channel slope and adding channel liners.

**Limitations:**

- May require watershed modeling and engineering design.
- Constructed channels must be stabilized so that they are not subject to the same erosion potential as the disturbed areas they are meant to protect.
- May require additional measures to ensure channel stability and function.

# PERMANENT DIVERSIONS RC-1

**Standards and Specifications:**

Open Channels for Stormwater and Diverted Stream Flows

- Permanent open channels must be designed by a professional registered engineer according to the criteria outlined in the drainage design manual of the appropriate jurisdiction.
  - Reno – Public Works Design Manual, latest edition.
  - Sparks and Washoe County– Hydrologic Criteria and Drainage Design Manual, latest edition.
- Refer to the drainage design manual of the appropriate jurisdiction regarding velocity limitations, channel liners, channel drops and energy dissipation structures.

Paved Flumes

- Divert stormwater runoff down the face of a slope without causing erosion problems on or below the slope.
- Outfall protection must be provided to prevent damage from high velocity flows.
- Maximum slope of the flume structure should not exceed 1.5H:1V
- Cutoff walls should be installed at upstream and downstream ends and along the length of the flume to prevent undermining.
- Anchor lugs should be placed along the length of the flume to prevent movement.
- Expansion joints and transverse joints should be placed along the length of flumes.
- Outlets must be protected using the appropriate energy-dissipating structures.

Outlet Protection

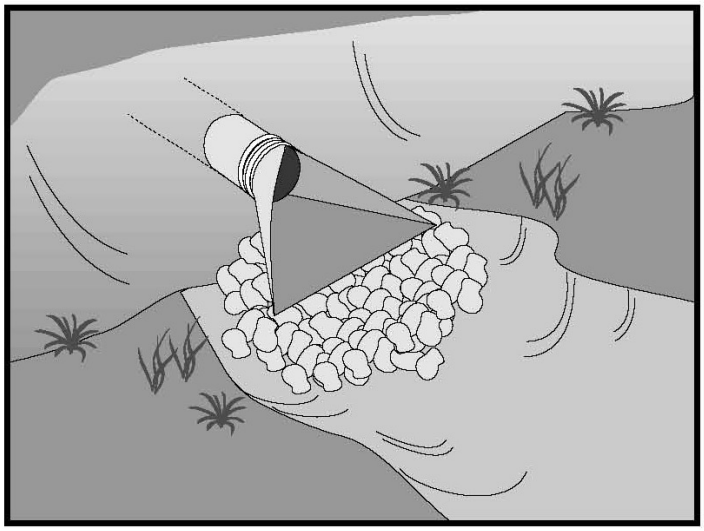
- Structurally lined aprons or other energy dissipating devices placed at the outlets of pipes to decrease the velocity of stormwater flows.
- No bends should be present in the horizontal alignment.
- Invert elevations should be equal at the receiving channel and at the downstream end of the apron.
- No overfall should occur at the end of the apron.
- Side slope of the receiving channel should not be steeper than 2H:1V.

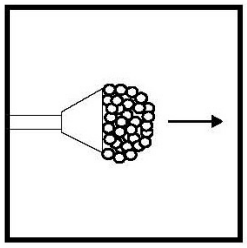
- Riprap, grouted riprap, concrete, or gabion baskets should be used to line the apron.
- Where velocities warrant, filter cloth should be placed between the channel and the riprap to prevent soil movement.
- Additional specifications are provided on the Stormdrain Outlet Protection (DP-2) fact sheet.

**Inspection and Maintenance:**

- Inspect channels and outfalls a minimum of once a week and after every rainfall until the area is stabilized.
- Inspect competency of rip-rap or channel lining after runoff events.
- Keep channels clear of sediment.
- Reseed areas if vegetative cover is not established.

# STORMDRAIN OUTLET PROTECTION DP-2





MAP SYMBOL

Graphics used with permission of Caltrans

**Purpose:** To reduce stormwater flow velocities and energy from construction sites by placing a section of rock at pipe outlets and within channels. Permanent installations must be designed per local standards noted in drainage design manuals.

**Application:**

- At locations where discharge velocities and energies may erode downstream reaches.
- Pipe, drain, culvert, conduit or channel outlets.
- At outlets located at the bottom of mild to steep slopes.
- At the outlets of channels that carry continuous flows.
- Outlets subject to short, intense flows of water.
- Points where lined conveyances discharge to unlined conveyances.

**Limitations:**

- Loose rock may be washed away during high flow events.
- Freeze and thaw cycles may break down grouted riprap.
- Inadequate drainage may cause grouted riprap to break up due to hydrostatic pressure.

# STORMDRAIN OUTLET PROTECTION DP-2

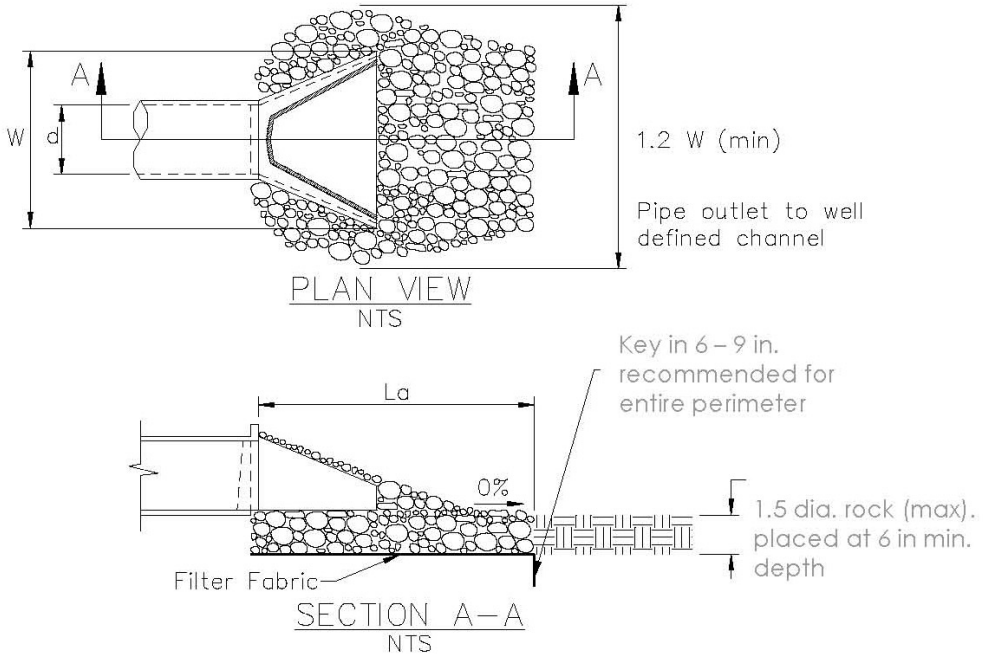
**Standards and Specifications:**

- Riprap, grouted riprap, or concrete aprons should be installed at all outlets. Riprap aprons are well suited for use during construction.
- Provide additional protection for outlets on slopes steeper than 10 percent.
- Higher outlet velocities require larger rocks.
- Minimum rock size is 6-inch diameter.
- Flow must be slowed to non-erosive velocity.
- The apron should be aligned with the receiving stream and it should be kept straight throughout its length. If a curve is needed to fit site conditions, place it in the upper section of apron.
- The underlying filter fabric should be protected with a gravel blanket if the riprap is too large.

**Inspection and Maintenance:**

- Inspect weekly and after every significant rainfall event.
- Check for displacement of riprap or damage to underlying fabric.
- Check for scour beneath the riprap and around the outlet.
- Replace riprap as needed.
- Repair damage to slopes or underlying filter fabric.
- Remove promptly all devices when the drainage area has been stabilized or at the completion of construction.
- Modify outlet protection if downstream erosion is evident.
- Remove temporary facilities from service when construction is complete. Outlet protection may be left in place if designed to be a permanent installation per local standards and specifications.

# STORMDRAIN OUTLET PROTECTION DP-2

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| **Pipe Diameter** in | **Discharge** $ft^3/s$ | **Apron Length, La** ft | **Rip Rap $D_{50}$ Diameter Min** in |
|---|---|---|---|
| 12 | 4.9 | 10 | 4 |
| | 9.9 | 13 | 6 |
| 18 | 9.9 | 10 | 6 |
| | 20.1 | 16 | 8 |
| | 30.0 | 23 | 12 |
| | 39.9 | 26 | 16 |
| 24 | 30.0 | 16 | 8 |
| | 39.9 | 26 | 8 |
| | 50.1 | 26 | 12 |
| | 60.0 | 30 | 16 |
| **For larger diameters or higher flows, consult a Registered Civil Engineer** | | | |

Source: USDA – SCS